Winrock International
Nigeria Farmer-to-Farmer Program

Rice Value Chain Analysis – Sokoto State Nigeria (NIG 244)

Volunteer Report:

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June 2012

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List of Acronyms

ADP	Agriculture Development Project
CBARDP	Community Based Agriculture & Rural Development Project
DAP	Di-Ammonium Phosphate
ET	Evapotranspiration
FAO	Food and Agriculture Organization
FtF	Farmer-to-Farmer
IFAD	International Fund for Agriculture Development
IRRI	International Rice Research Institute
NGO	Non-Government Organization
UN	United Nations
USA	United States of America
USAID	United States Agency for International Development

Executive Summary

The rice value chain analysis was undertaken at the request of IFAD-CBARDP. The analysis looked how rice was produced, processed and ultimately marketed to the consumers. The objective was to see how the value chain could be enhanced for the primary benefit of the smallholder producers.

The analysis indicted the value chain was similar to the value chain of most commodities produced and marketed domestically in financially suppressed economies common to the developing world including Nigeria. That is the value chain was dominated by a multitude of small family enterprises, each vying for a limited market share. This includes the smallholder producers as family enterprises. The value chain could be conveniently divided between production which is mostly the farmers and support services, processing which is a combination of parboiling and milling, and marketing which is mostly bulk through the open air markets.

Enhancing the value chain for the benefit of the smallholder producers should start at the production end where the smallholder farmers have the most direct involvement. Here the initial need is to increase the rice area allocated to each farmer, so the farmers will concentrate on rice production as their primary farm enterprise. With the present small allocations farmers have little incentive to concentrate on rice cultivation. Instead they rightfully concentrate on other crops such as millet, sorghum, and cowpeas from which they derive most of their income of subsistence production. Allowing or encouraging farmers to manage up to six hectares of rice lands will move them more to being full time rice farmers, and become disengaged from other crops.

The second concern would be to remove the drudgery from the farming operations. Currently most of the management is manual, and the farmers just don't have the time or dietary energy to effectively grow rice or other crops in a timely manner for the optimal yields possible with their physical environment. Thus the need is to facilitate forms of mechanization such as contract access to tractors for upland cultivation or individual ownership of power tillers for paddy use. Also, mechanical combines or threshers at harvest to improve both the grain recovery and minimize the contamination from stones and mud clods, as well as chaff and empty grains.

In addition to production, the next point for enhancing the value chain would be in the processing. While there does not appear a major problem with the parboiling quality, it does provide long term health hazard to the women tending the fire. Thus the need is to look at alternative vats to see if less smoky vats currently being developed and promoted by some NGOs can be introduced and accepted. They may have to be promoted more for the short term reduced firewood consumption than the long term health problems. Alternatively evaluate the prospect of shifting to propane as the primary energy source in rural areas. This would be similar to what is being done in Iraq under a similar macro-economic environment, in which the benefits from the

oil industry do not reach the general population. This could also have a positive environmental effect of enhancing the prospects for any reforestation programs.

Also, the processing needs to look at shifting from the single phase mills to two-phase single pass mills. These will not only reduce the amount of broken grain to improve the quality of the milled rice but also result in 50% increase in recovery. The increased recovery should more than justify the shift to the improved mills. Such mill can produce a satisfactory quality for rice, slightly below the international standard, but sufficient to locally compete with imported rice.

There is more limited prospects for enhancing the marketing component as it will most like remain dominated by bulk sales from open air markets. The prospects of getting involved in bagging small quantities for supermarket and convenience store sales can be evaluated, but needs to be done carefully to make certain the extra costs are fully recovered, and there is enough demand to justify the costs of any necessary equipment. Also, if undertaken it will most likely be done after processing and after the farmers have given up control of the rice. The demand for this type of packaging could be reduced when convenience store undertake this value added on their own.

Much of the potential enhancements of the value chain will require some substantial capital investment. Thus there will be the need for some form of institutional credit. However, this may require considerable revamping of the rural credit system to allow fairly large loans needed for the individual purchase of the equipment that can then at least partly serve as collateral for the loan, plus smaller unsecured loans to cover the operational costs to allow some contract services to be done on credit with in-kind repayment after harvest.

Given the farmers desire for cash transactions and retaining the rice in kind for as long as possible, it is highly unlikely that the farmers will want any direct involvement once the rice is sold to the local buyer. Thus they would prefer to out-source most of the value added and concentrate on their production, then be directly involved in value added activities. This will be particularly true for the labor intensive parboiling processing.

Finally, be careful about relying on farmer organizations for provide support services. While these have been heavily relied upon for a couple decades, a closer look might indicate that the accompanying administrative procedures are too cumbersome and too inconvenient so any negotiated benefits are quickly consumed in the overhead costs, and farmers wisely divert the bulk of their business to other service providers. Thus they ultimately require continuous external facilitation and subsidies, yet still do not attract enough market volume to have any major impact on the poverty alleviation of smallholders.

Rice Value Chain Analysis – Sokoto State Nigeria (NIG 244)

Consultant Report:
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Farmer-to-Farmer Volunteer
June 2012

Introduction[2]

The Farmer-to-Farmer (FtF) volunteer value chain evaluation was undertaken at the request of IFAD-CBARDP[3] as part of their effort to assist with the National goal of increased rice production in Nigeria and avoid the need for expensive imports, mostly from Thailand. The value chain analysis is a review of how rice gets from the producer to the consumer and how this can be improved to the benefit of the smallholder producers and other in the value chain. The idea behind the value chain is to assist farmers with the vertical integration of their produce in the hope this will provide additional returns to the farmers. It is based on examples where farmers' cooperatives in the USA have gain national consumer brand name recognitions. This would include Land o' Lakes dairy products, Florida Natural orange juice, and Ocean Spray Cranberries. However, not all such efforts have been successful as noted by Farmland, the conglomerate of Cooperatives whose attempt at vertical integration as a national consumer brand name lead to the largest cooperative bankruptcy debacle in history[4]. The value chain for rice, as with most crops, is divided into three primary components: production, processing and marketing, with various links between them, mostly associated with transport.

IFAD-CBARDP

The host for the evaluation was IFAD-CBARDP. This is part of the Sokoto State Agriculture Development Project (ADP) in which IFAD enhances the operational funds for the ADP to assist it in undertaking various community based agriculture development programs. One of these programs it to collaborate with the National effort to become self-sufficient in rice production. There are really too issues here, one being the amount of rice produced and the other the quality of rice in terms of the amount of foreign material, particularly stones that ultimately have to be

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[2] This report is written as an evaluation of the rice value chain in accordance with the scope of work provided that makes no mention of training.

[3] IFAD (International Fund for Agriculture Development); CBARDP (Community Based Agricultural Rural Development Project)

[4] http://www.foodproductiondaily.com/Processing/Farmland-Industries-files-for-bankruptcy

removed so people don't bite them when eating with the potential of damaging teeth, and the degree of broken grains in the final milled rice. Both distracts from the appearance of the rice but not necessarily the nutrient value, but do result in lower price to the farmers. The hope is rice produced and processed by smallholder communities in Nigeria will be comparable to international standards.

Financially Suppressed Economy

While Nigeria has considerable oil reserves and received royalties from its development and export, little of that appears to reach the general public. Thus, most Nigerians operate in what might best be described as a financially suppressed economy[5]. This is a relative term in which consumer prices, particularly of goods produced in a host country such as Nigeria, are only a fraction of what they are in the USA (Table 1), but wages are suppressed even more, often about 1/12th the comparable USA wage. The result is that most people have to use the majority, perhaps 80% of their income just to buy the minimal amount of food needed for their family to survive from day to day. From a value chain perspective this means that, while enhancing the value chain with increase quality of rice, this cannot be reflected in an increase in consumer prices above which an impoverished population can afford. Unfortunately, too often an increase in quality is accompanied with increased production and processing costs that have to be passed on to the consumers. Thus, it is important that the increase in costs does not exceed the consumer price people can afford. As it is the per kilogram bulk price for local rice in the open market in Kano in 2009 was almost the same as small packages of rice in the major USA supermarket chains (Table 1). Thus in relative terms rice in Nigeria is expensive.

Table 1. Comparative Consumer Prices (Nigeria vs. USA)

Commodity	Nigeria Price		US Price		Adjusted to US$ & Common Unit			Comparison Ratio
	Price	Unit	Price	Unit	Nigeria	US	Unit	Ni/US
Dry Goods								
Flour	107	kg	0.23	lbs	0.71	0.50	Kg	1.43
Sugar	160	kg	0.58	lbs	1.06	1.27	Kg	0.83
Salt	38	kg	0.49	lbs	0.25	1.08	Kg	0.23
Pasta	200	kg	0.74	lbs	1.32	1.63	Kg	0.81
Rice (local pb)	400	mudu	0.50	lbs	1.06	1.10	Kg	0.96
Veg.Oil	300	lit	1.54	qt	1.99	1.45	lit	1.37
Tea	4	bag	0.03	bag	0.03	0.03	bag	0.97
Coffee	4,600	kg	9.98	lbs	30.46	21.96	Kg	1.39
Cowpeas	370	mudu	0.54	lbs	0.98	1.19	Kg	0.83
Sesame	500	mudu	3.39	lbs	1.32	7.46	Kg	0.18
Groundnuts	350	mudu	1.50	lbs	0.93	3.30	Kg	0.28
Dairy								
Eggs	25	ea	0.11	ea	0.17	0.11	ea	1.51
Milk Power	1,444	kg	3.42	lbs	9.57	7.52	Kg	1.27
Meat								
Beef	800	kg	3.99	lbs	5.30	8.78	Kg	0.60
Goat	400	kg	3.98	lbs	2.65	8.76	Kg	0.30
Fish	250	kg	5.49	lbs	1.66	12.08	Kg	0.14
Canned Fish	944	kg	3.29	lbs	6.25	7.24	Kg	0.86
Vegetables								
Tomatoes	100	kg	3.99	lbs	0.66	8.78	Kg	0.08
Carrots	250	kg	0.60	lbs	1.66	1.32	Kg	1.25
Beans	250	kg	1.25	lbs	1.66	2.75	Kg	0.60
Onions	250	kg	0.66	lbs	1.66	1.46	Kg	1.13
Eggplant	60	kg	1.59	lbs	0.40	3.50	Kg	0.11
Potatoes	83	kg	0.99	lbs	0.55	2.18	Kg	0.25
Sweet Potatoes	50	kg	1.49	lbs	0.33	3.28	Kg	0.10
Cabbage	100	kg	0.59	lbs	0.66	1.30	Kg	0.51
Cucumbers	100	kg	0.99	lbs	0.66	2.18	Kg	0.30
Fruits								
Plantain	150	kg	1.49	lbs	0.99	3.28	Kg	0.30
Bananas	200	kg	0.50	lbs	1.32	1.10	Kg	1.20
Pineapples	300	ea	4.99	ea	1.99	4.99	ea	0.40
Papaya	600	ea	2.98	ea	3.97	2.98	ea	1.33
Other								
Gas	65	lit	2.15	gal	0.43	0.57	lit	0.76
Diesel	116	lit	2.59	gal	0.77	0.69	lit	1.12

Exchange rate US$ = ₦ 151 Date: 23 September 2009
mudu local vloume measure approximately 2.5 kg for dry goods

[5] http://lamar.colostate.edu/~rtinsley/FinancialSuppressed.htm

Smallholder Producers

Within this suppressed financial environment are a multitude of smallholder producers trying to eke a living from limited amounts of labor restricting and amount of land they can effectively manage. However, these smallholders may best be thought of as individual private entrepreneurs, business people if you will and fairly astute business people as demonstrated by their continued survival. While for lack of opportunity, they may have limited formal education that does not distract from their inherent intelligence. They are inherently first good economists and then experienced agronomists in the art of farming. They have to be in order to **maximize the total return from all their diversified farm enterprises**. Thus with the limited operational resources to manage their land, mostly family labor, they will compromise on the ideal management, as shown in extension demonstration, to either extend the area cultivated or promote another crop. In the cases of the areas visited, rice in Sokoto represented only a small fraction of the farmers' holdings, with considerable greater area devoted to other crops, mostly millet and cowpeas. This sets up a possible conflict between irrigated paddy lands and non-irrigated uplands. When this occurs the farmers invariable give their first priority to the non-irrigated lands before working the irrigated lands. The reason being that to give priority to the irrigated areas, even if they have a higher yield potential, the non-irrigated lands will be lost for the season. The irrigation system provides the managerial flexibility to the paddy areas. The delay in addressing the irrigated paddy lands will often be six to eight weeks.

Smallholder production usually involves large amounts of manual labor with an underlying assumption that labor is relatively available[6]. This perception needs to be carefully reviewed as most smallholders have limited available labor and are maxed out to the extent their overall numbers and energy will allow. This then causes a major drag on the yield potential as demonstrated with most research/extension demonstration. Such demonstration do an excellent job of showing what the physical potential of an area is, but do not factor in the limited operational resources the famers have to extend the small plot results across their farms and communities, nor the interaction with other crops the farmers may be involved with. One impact of a possible severe labor shortage on the value chain analysis is that farmers may be more interested in and financially better off out-sourcing any valued added then activity participating in value added efforts.

The underlying problem is the analysis of the operational resources needed to extend extension demonstrations across a field and community falls in an administrative void in the overall rural development effort with no one taking responsibility for the analysis. The default assumption for some 40 years has been unlimited available labor, and the emphasis on labor intensive innovations, into what is more likely a labor deficit environment, resulting in involuntary prolonged crop establishment time, and rendering many recommendation null and void. This

[6] http://lamar.colostate.edu/~rtinsley/BasicPremise.htm

assumption on excess labor has misled the development effort for some four decades and been a major disservice to the smallholder producers.

Dietary Energy Balance

While it is well recognized that most smallholders are poor and perhaps hungry, this has never been factored in as a possible hindrance to agronomic or other farm management activities[7]. Typically a person needs some 2000 kcal of dietary energy just to meet their basic metabolism, without undertaking any major physical effort as in manual farm work. To undertake manual farm work requires anywhere from 270 kcal/hr for moderate work such as weeding, etc. to over 340 kcal/hr for heavy land preparation work for a total daily calorie requirement in excess of 4000 kcal. Typically smallholders are lucky to have a 2000 kcal daily diet, as illustrated by the Millennium Village Project in East Africa that allocates 1.1 mt. of maize for a family of 5.7 people. This comes to only 1930 kcal/person/day. This is marginally enough to meet basic metabolism needs leaving little energy to undertake and sustain hard physical field labor. The net result is that the work day can be limited to three hours of diligent effort, or perhaps paced to five or six hours with less diligent effort. This will then extend the time to complete various task, reduce the quality of the work and appreciable lower yield potential and quality for high valued crops. It also may explain why farmer crop establishment and other agronomic activities are spread over a considerable longer period than anticipated, perhaps up to eight weeks. From a value chain analysis it means one potential way to increase crop production is to concentrate on drudgery relief instead of labor intensive innovations, as is often recommended.

Thailand Rice Model

In reviewing the rice value chain for Nigeria, it might worth examining rice production in Thailand as the model for a highly productive smallholder rice program. Thailand is the world's largest exporter of rice by a large margin. Most of this rice is produced by smallholder farmers. Typically these farmers will manage upward of six hectares of paddy. They will be assisted with individually owned rice power tiller (Fig. 1) that can also power low lift pumps (Fig 2), or pull small trailers. They will also have contract access to small combines (Fig 3) that can easily operate in their standard one rai ($1/6^{th}$ ha) fields to harvest, thresh and cleanly bag paddy in about an hour or in excess of a hectare per day. For the most part their land will be fully surface irrigated

Fig. 1. Asian Rice Farmer Using Small Rice Based Power Tiller Ideal for Working in Paddy.

[7] http://lamar.colostate.edu/~rtinsley/CalorieEnergyBalance.htm

all year with limited need for low lift pumps so the farmers are able to produce five crops every two years, an increase in cropping intensity from two irrigated crops per year. Most of this rice is now direct seeded instead of transplanted. These smallholder are now reasonable well off, typically owning such comfort things as refrigerators, gas stoves, TV with VCRs, motor cycles or pickup, and naturally cell phones. It should also be noted once the conversion from water buffalo to power tiller and their rice cultivation was under control, farmers spontaneously diversified into various high value enterprises such as aquaculture, with poultry suspended over the pond (Fig. 4), and contract farming of vegetables for the Japanese market. If the Thai farmers can achieve this, so can the Nigerian rice farmers if provided a suitable overall economic environment.

Fig. 2. Power Tiller Use for Low Lift Pumping From Canal In Thailand

Fig. 3. Small Combine Used For Contract Harvesting Of Rice In Thailand.

For the Nigeria rice value chain it should consider that full time rice farmers need access to about six hectares of rice land, have power tillers for establishing and managing their rice, access to combines for harvest, threshing and bagging, etc.

Yield Expectations

When considering paddy rice there is a need to develop some expectation of what yields to expect. In this regards for ponded paddy production in the low altitude tropics:

- >7 mt/ha would be considered an exceptional yield
- 6 mt/ha would be a good target yield
- 5 mt/ha would a reasonable yield
- 4 mt/ha would be an acceptable
- < 4 mt/ha would be marginal yield

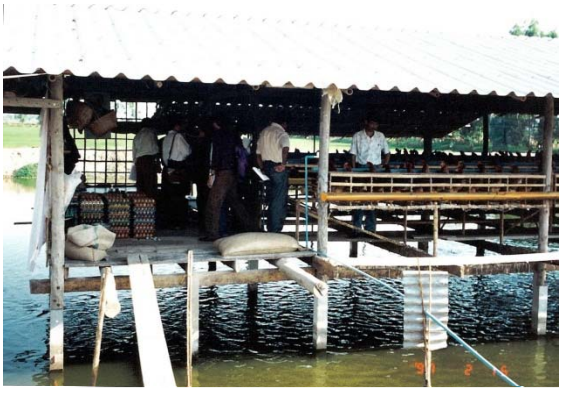

Fig. 4. Poultry Operation Over Fish Pond, Possible Once Thai Farmers Acquired Power Tillers to Expedite Rice Cultivation.

These yields would not hold for rice produced under casual management associated with deep-water conditions or upland non-ponded conditions. Under these conditions the potential yields

will be considerable lower. Nor could Nigeria expect to reach the 13 mt/ha yield of Egypt. This represents a sub-tropical desert climate with long cloudless days and cool evening as well as cool winters that restrict rice to one crop/year.

International Rice Standards

With the governments interest in meeting or approaching the international rice standards, it might be well do stipulate what they are in terms of foreign material, grain size, broken grains, un-milled paddy, and discolored grains etc. and do this for Thai Parboiled rice, the type of rice most commonly imported into Nigeria and preferred by most Nigerians (Fig. 5). Rice meeting this standard has a minimal amount of foreign material or broken grains (Fig 6)

Rice Value Chain – Production

Limits of Agronomy

Before getting into the details of rice production one of the concerns with the production aspects of a value chain analysis of rice or any crop is the limits of small plot agronomic research and extension demonstrations. Such efforts do a very good job of determining the physical potential of an area. However, they cannot determine the economic optimal level of any inputs that maximize the farmers' returns and above which the extra yield in worth less than the cost to obtain it. They also cannot factor in the limited operational resources the farmers have to extend the research demonstration results across their farms and communities, or integrate the management of the demonstrated crop with the other crops and farm enterprises the farmers are involved with, and the priority they give to each. The operational resources include labor, access to mechanization and other things needed to fully manage a crop at the optimal level.

The problem is that the analysis of the operational resources has fallen through the administrative cracks in the rural development effort to assist smallholders with the default assumption of being infinitely available. In the overall development effort, who among the donor or host communities is responsible to determine the amount of labor, machinery, etc. needed to extend a research demonstration results across an entire smallholder farm and community in the time allocated, and if these resources are available? Or perhaps more critical who should inventory what is available and, based on that, estimate how long it will take to compete various agronomic tasks, compared to the time allocated for the activity, either implied if not actually stated, as well as how any delays will impact on potential yields. Within the IFAD-CBARDP who could or should take this responsibility and include not only what is needed for the promoted rice production, but also that needed for the more extensive millet and cowpea production so that can be expedited and allow farmers to more rapidly attend to rice cultivation.

Thai Standards for Parboiled Rice

Grades	Grain Classification		
	Long grain		Short grain
	Class 1+ Class 2	Class 3	
100% Sorted	≥ 60%	-	≤ 10%
100%	≥ 60%	-	≤ 10%
5% Sorted	≥ 45%	-	≤ 20%
5%	≥ 45%	-	≤ 20%
10% Sorted	≥ 30%	-	≤ 20%
10%	≥ 30%	-	≤ 20%
15%	≥ 25%	-	≤ 30%
25%	≥ 25%	-	≤ 30%
Broken rice A1	-	-	-

Long grain class 1 means whole kernel with a length exceeding 7.0 mm.
Long grain class 2 means whole kernel with a length exceeding 6.6 mm up to 7.0 mm.
Long grain class 3 means whole kernel with a length exceeding 6.2 mm up to 6.6 mm.

Grades	Grain composition					Size of Head rice (parts)	Size of Brokens (parts)
	Whole Kernels	Head Rice	Brokens and Small brokens C1				
			Total[1]	Brokens[2]	Small brokens C1		
100% Sorted	≥ 80%	-	≤ 4%	≤ 0.5%	≤ 0.1%	≥ 8.0	≥ 5.0 - < 8.0
100%	≥ 80%	-	≤ 4%	≤ 0.5%	≤ 0.1%	≥ 8.0	≥ 5.0 - < 8.0
5% Sorted	≥ 80%	-	≤ 7%	≤ 0.5%	≤ 0.1%	≥ 7.5	≥ 3.5 - < 7.5
5%	≥ 80%	-	≤ 7%	≤ 0.5%	≤ 0.1%	≥ 7.5	≥ 3.5 - < 7.5
10% Sorted	≥ 75%	-	≤ 12%	≤ 0.7%	≤ 0.3%	≥ 7.0	≥ 3.5 - < 7.0
10%	≥ 75%	-	≤ 12%	≤ 0.7%	≤ 0.3%	≥ 7.0	≥ 3.5 - < 7.0
15%	≥ 70%	-	≤ 18%	≤ 1%	≤ 1%	≥ 6.5	≥ 3.0 - < 6.5
25%	≥ 60%	-	≤ 28%	-	≤ 2%	≥ 5.0	< 5.0
Broken rice A1	-	-	-	≤ 10%	≤ 6%	-	-

[1] including brokens not passing through sieve n°7 & C1
[2] not reaching the minimum specified parts and not passing through sieve n°7

Grades	Rice and matter that may be present, not exceeding									Milling degree
	Red and/or undermilled Kernels	Yellow kernels	Black kernels	Partly black and Peck kernels		Damaged kernels	Glutinous rice	Paddy (Grain per kg)	Undeveloped, immature kernels, other seeds and foreign matter, singly or combined	
				Total	Partly black kernels					
100% Sorted	0.5%	0.25%	0.10%	1.5%	0.50%	1.0%	1.5%	3%	0.2%	Extra well milled
100%	0.5%	0.50%	0.25%	2.5%	1.00%	1.0%	1.5%	5%	0.2%	Extra well milled
5% Sorted	1%	0.50%	0.15%	2.0%	0.75%	1.0%	1.5%	5%	0.2%	Well milled
5%	1%	1.00%	0.25%	3.0%	1.50%	1.0%	1.5%	10%	0.2%	Well milled
10% Sorted	2%	0.75%	0.20%	2.5%	1.00%	1.5%	1.5%	5%	0.4%	Well milled
10%	2%	1.50%	0.25%	3.5%	2.00%	1.5%	1.5%	10%	0.4%	Well milled
15%	5%	2.00%	0.50%	4.0%	2.50%	1.5%	2.5%	10%	0.7%	Reasonably well milled
25%	7%	3.00%	0.75%	4.5%	3.00%	1.5%	2.5%	10%	1.0%	Ordinarily milled
Broken rice A1	-	-	-	-	-	-	-	-	1.0%	-

Extra well milled is the removal of bran entirely to the extent that the rice kernel has a specially beautiful appearance.
Well milled is the removal of bran entirely to the extent that the rice kernel has a beautiful appearance.
Reasonably well milled is the removal of a large amount of bran to the extent that the rice kernel has a reasonably beautiful appearance.
Ordinarily milled is the removal of some portions of bran only.

Fig. 5. Quality Standards for Thai Parboiled Rice. Source: http://www.ricelandgroup.com/Quality.html

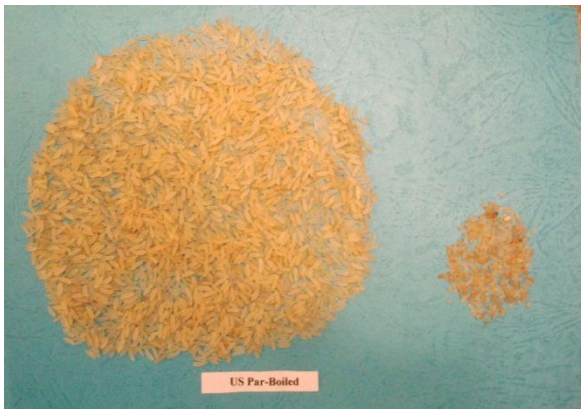

Fig. 6. Parboiled Rice from US Meeting International Standards for Broken and Foreign

Unfortunately, in the absence of someone assuming responsibility for quantifying the operational resources available to smallholders, the assumption is they are readily available. Thus, for over 40 years the development community as assumed nearly infinite labor supply and promoted labor intensive innovations into what is more like a labor deficit environment. Then blame the, limited educated, smallholder farmers for not appreciating

and adopting the demonstrated highly productive technology.

The impact of the limitations of agronomy is the emphasis on demonstration plots to teach farmers improved technology that invariability includes emphasis on early crop establishment. And for which the farmers most likely are well aware of but do not have the means to fully utilize. This makes for good shows, but since they do not measure the drag on the yield involuntarily imposed by the smallholder producers' limited resources to manage all his lands at the economic optimal level have little impact on farmers' crop management.

Rice Production Areas Visited

Four rice production areas were visited during the assignment. Two of these represented areas where IFAD-CBSRDP was actively trying to introduce and promote rice.

Kwarre: The first rice area was Kwarre. This was an area where IFAD-CBSRDP was introducing and promoting rice growing to a community that was mainly millet and cowpea producers. Thus, farmers had to integrate the allocated 0.5 ac of paddy land with several acres of upland millet and cowpeas. Thus, the farmers should be expected to derive the bulk of their income or subsistence production from millet and give it first priority in managing their limited resources, with rice a distant secondary interest.

Fig. 7. Small Petrol Pump Used for Irrigation from Shallow Wells

The area appeared to have been selected primarily because of a shallow water table that could be easily tapped with undeveloped wells using small 5 hp petrol pumps, more often associated with vegetable production (Fig 7).

These pumps were to be shared among several farmers. They appeared to have a discharge of about 3 lit/sec (Fig. 8). However, in the absences of any hard infiltration data or climatic data to determine evapotranspiration (ET), irrigated paddy requires an estimated continuous flow of 1 lit/sec to meet its water requirements for both ET and infiltration. To meet this water requirement these pumps would have to run almost continuously to have any chance of maintaining reasonable continuous ponded conditions. However, these pumps are also

Fig. 8 Discharge from Small Pump of approximately 3 lit/sec.

highly portable and easily carried by an individual even when riding a donkey (Fig. 9). Thus, if left unattended the pumps could easily be stolen. This would restrict the time farmers could spend irrigating their rice as they, or some responsible person, would have to remain with the rice and do other rice management activities while irrigating. It would also restrict any nighttime irrigation that could help compensate for any limited daytime irrigation. However, if they spend most of their time managing their millet, then the rice would not get sufficient water. This was noticed by the rice being somewhat stunted (Fig. 10) and the estimate yield of only 2.5 mt/ha, most of the low yield could be attributed to multiple short periods of drought stress days accumulated over the growing season[8]. This would be on the marginal side of rice yields as mention previously, and given the cost of pumping may be questionable profitable.

Fig. 9 Small Pump Being Easily Transported with Donkey and thus security Risk.

Fig. 10. Rice Crop Somewhat Stunted with Limited Yield Due to Lack of Continuous Ponding.

When visited some of the crop was approaching physiological maturity and they were harvesting one plot (Fig. 11). However, the field did not appear to have senesced and dried down as much as expected or desired. The guess would be that, while the grains may have been completely filled, the moisture would be between 25% and 30%. Thus if harvested it would have to be fairly quickly dried down to the accepted storage moisture content of 14%. In reality the farmers need to balance the maturity of the grain, with moisture content and prospects to quickly dry it, with the late season pre-harvested losses from rats, birds, shattering, etc. as well as the labor available for harvesting and threshing. Birds seem

Fig. 11. Harvesting Rice Just as Reaches Physiological Maturity but With Relatively High

[8] A water stress day in rice is defined as the number of days in excess of three in which the rice is not ponded and then accumulated over the whole season, with each re-ponding restarting the non-ponded days,

to be a problem of some magnitude in the area as snare nets were set around some fields that were effectively snaring some of the birds swooping to enter the rice fields (Fig. 12).

Fig. 12. Small Weaver Bird Snared in Rice Field.

One additional concern for the area is the perception that some of the rice management is done in "Estate Mode". Estate Mode is when some coordinating agency, like IFAD-CBARDP, attempts to manage a group of small holders as a consolidated unit, disregarding farmers' crop management priorities, established property boundaries, including water retention bunds that will need to be manually and laboriously replaced each year. While on paper this appears possible from an efficient land use perspective, it has ultimately proven unsustainable and was fully discredited some 100 years ago in the multi-million hectare Gezira Irrigation Scheme the British developed for cotton outside of Khartoum, Sudan at the confluence of the Blue & White Niles.

The basic reason for the failure is the well-known declining production function with time of planting. Thus when Estate Mode is applied, particularly over large areas, those who are served first are at a distinct advantage to those served later, with the unfortunate late served group clearing knowing who is responsible for their misfortunate and it is the coordinating organization. In the Kwarre project the rice areas was small enough that all the basic mechanical land preparation could be done in a few days, and thus may not have noticeable yield decline between first and last served, but still the historic context needs to be carefully considered. However, even when the land preparation was consolidated and done quickly, the spread of crop management appears substantial, perhaps representing a typical spread of four to six weeks (Fig. 13). This is most likely attributed to interaction with the millet and different farmers taking more or less time working on millet, before concentrating on rice.

Fig. 13. Typical four to six week spread in crop activity, with forefront heading, the middle still tillering and far field already mature.

Goyonro: The next rice area was in the Goyonro area. Here there were really two areas. The first was again an area the program was trying to introduce rice, using similar techniques of low lift pumping from shallow undeveloped tube wells. Here the soil appeared a little more clayey and more easily retained water, and the rice looked less water stressed (Fig. 14). However, the important concern was the overall land use. It was presented as a flood prone area in which deep water elongating rice varieties might be a good fit. These varieties can withstand the estimated 1.5 meters of flooding. They were widely grown in Thailand, Cambodia, and Viet Nam. This will have to be referred to IRRI or AfricaRice to see if any work has been done for these areas in the past and what type of collaborative work might be possible in the future.

Fig. 14. Second Areas Rice Was Promoted Using Small Pumps From Shallow Tube Wells, This Time With Heavier Soil, Better Ponding And Higher Yield Potential.

Deep water rice is a considerable more casual rice technology, of simply planting and coming back to harvest. The flooding virtually eliminates most intermediate activities such as weeding and fertilizing. However, the potential yield is low, but consistent with the labor involved.

The current interest is in concentrating along the fringes and getting an early maturing crop mature before the flooding. This can be done and has succeeded in other deep water areas, however, it can be a fairly sensitive crop to manage as the window for crop establishment is more restrictive than normal, and the time of flooding can be unpredictable, over about a six week range. Thus the technology may be something easy to demonstrated, but difficult for wide spread farmers adoption.

The next rice area in Goyonro was a fully irrigated area of over 3000 ha, below a dam. This was an organized rice irrigation scheme but with farm allocations of only one acre. This is not enough for full time rice farming and farmers were still managing additional and more extensive non-irrigated lands outside the scheme, again used mostly for millet and cowpeas. The rice fields were nicely laid out to be long and narrow strips stretching from the irrigation canal to the drain (Fig 15). This may not be the most

Fig. 15. Fully Irrigated Area With the Field Long and Narrow Stretching From the Canal To Drain and Insuring Easy Direct Access for Each Farmer.

ideal configuration from the engineering perspective, but from the farmers perspective it is operationally better in providing good access independent of the neighbors and should be evaluated for the convenience and possible farmer preference. The only other place this configuration has been seen is Central Luzon, in the Philippines. They also extracted water from the canal with siphon tubes. This is unusual for smallholder irrigation, but most likely limits the water any one farmer can take and thus assures an equitable distribution of water (Fig. 16) through the secondary or tertiary canals and should be encouraged as it prevent breaking of the canal banks to various widths and thus variable amounts of water to enter given fields that favors those at the head of the distribution canals. This can be a major problem in most smallholder irrigation schemes.

Fig. 16. Syphon Tubes Used to Take Water from Canal to Field, Unusal in Smallholder Irrigation but Should Be Effective in Assuring Equal Distribution of Water Between Farmers.

The paddy work was all manual with no mechanization available. The yields were mentioned as 3.5 mt/ha. Still the yields are less than desirable particularly for area with complete water control. With the limited yield, size of the area, and degree of water control, this might offer the best prospects of increasing the national rice production.

Kebbe: This area represented a large, perhaps as much as 200,000 ha, flood prone area that might be suitable for deep water elongating lines. The flooding was just beginning and it was impossible to do more than observe from the road (Fig 17). It did highlight the need to take a serious look at the prospects for deep water rice in Nigeria, not only in Sakoto but other areas such as Adamawa State as well. Again this needs to be examined by the national rice research program in conjunction with IRRI and AfricaRice. An inquiry was made to see what might be possible, but the initial response was more limited than expected and may need some additional follow-up.

Fig. 17. Large Areas for Possible Deep Water Rice Production That Needs Evaluation.

Agronomic Practices

Looking at the different agronomic practices as to where to increase yield or quality, there are several areas that might be worth considering.

Land Preparation & Crop Establishment: The initial land preparation and crop establishment, the very starting gun for crop production, appears to be mostly manual. This represent a lot of hard drudgery which with the limited calories in most smallholders' diet most likely represents a serious labor shortage and results in prolong crop establishment period, often extending up to eight weeks. During this period the yield potential declines according to typical time of planting evaluations. In addition, the extended crop establishment period also means the return the first planted fields for mid-season activities, such as weeding, will be delayed so the infestations will be more severe, take more effort to complete and not result in the best quality work, all of which will further restrict the potential yields. Thus there is a need to look at providing access to mechanization to expedite the entire process. It also has to be recognized that when both paddy lands and uplands are cultivate farmers have both land uses completely interlinked in their operational plans. Thus, it might be considerable easier to help mechanize the millet establishment then the paddy. This should be encouraged with the expectation that enhancing a second farm enterprise will ultimately enhance the enterprise of primary interest.

Variety & Seed Quality: IFAD-CBARDP working closely with the government tends to promote FARO 44 as the primary rice variety for ponded but not deeply flooded paddy conditions. While this is a good variety, in large rice tracks it is usually desirable to promote the use of several varieties. This will prevent the difficulties suffered in Egypt some years back. There the government insisted on one variety. However, when that variety's resistance to the blast fungus broke down the entire crop was lost. When three or four varieties are grown in nearly equal amounts, this can be avoided. Usually, there will be three or four top varieties or breeding lines that cannot be statistically separated, the best lines jumping around from year to year as illustrated in a small variety trial in Madibira, Tanzania (Table 2).

Table 2. Two Year Yield Comparison of Rice Line

Variety	Yield (t/ha) &Ranking ( )						
	1999		2000		Average		Difference (2000 – 1999)
Line 85	7.19	(3)	8.71	(1)	7.95	(1)	1.52
Subarimati	6.33	(5)	8.12	(2)	7.22	(2)	1.79
NARO TAC	6.40	(4)	7.27	(4)	6.84	(3)	0.87
PSBRc 28	8.64	(1)	4.73	(6)	6.60	(4)	-3.73
IET 1444	7.72	(2)	5.11	(5)	6.41	(5)	-2.61
Line 88	4.98	(6)	7.71	(3)	6.35	(6)	1.37

The importance of certified seed is also appreciated, but the question is how reliable is the certification program and the logistics including the cost to reach remote areas for each season. Thus, is it worth the extra cost that is often double the price of market seed, and are the farmers willing to pay the extra? Or would it be better to pump limited amounts of certified seed into an area and encourage responsible people in the community to undertake the final multiplication, so that farmers have access to seed only three or four generations removed from certification[9]? Is there really an effective alternative to serve smallholder communities?

[9] http://lamar.colostate.edu/~rtinsley/Genetic%20Pump2.pdf

Unfortunately, the seed certification program in Nigeria can be overwhelmed by the task at hand. In Kano State there is only one seed certification team for the entire state that needs to make three inspection visits each season to a multitude of fields most of which are less than a hectare, and do this with limited access to transportation for which they often have to rely on the seed producers to provide. This is logistically impossible and thus most of the seed certification has to be done on the honor system or perhaps a combination of honor with small gratuity. It also appears that most of the certified seed is sold to the government for distribution to farmers under a subsidize support system. Often the seed arrives too late to be effectively distributed, and ends up stacked at the entrance to the ADP offices, such as the case in Benue, with no variety identity (Fig. 18). As stored, by the time it would be distributed for the next crop, the germination could become questionable. Under these conditions it might be difficult to show a yield advantage for the certified seed compared with market seed. This was the case for the project in Madibira, Tanzania where a comparison of seed of different varieties could not separate between project seed and market seed (Table 3).

Fig. 18. Undistributed "Certified" Rice Seed Abandoned at Entrance to Benue ADP

Table 3. Yield Comparison of Project and Farmers' Seed for 3 Varieties

Subarimati		Zambia		IR 54	
Source	**Yield (t/ha)**	**Source**	**Yield (t/ha)**	**Source**	**Yield (t/ha)**
Project	1.72	Project	0.61	Project	1.44
Farmer 1	2.24	Farmer 4	1.11	Farmer 7	0.97
Farmer 2	2.01	Farmer 5	1.01	Farmer 8	1.68
Farmer 3	1.56	Farmer 6	0.42	Farmer 9	2.28
Ave.	1.89	Ave.	0.79	Ave.	1.59
Std. Dev	0.57	Std. Dev	0.57	Std. Dev	0.80

Thus while it may be possible for IFAD-CBARDP to provide certified seed to the limited area in which it is promoting rice production with the small pumps each growing season, it would be unlike it could do so for the major rice growing area visited. Thus is a need to look at alternative for getting reasonable quality seed into rice producing communities and allow the final multiplication and distribution to take place in the communities, possible working through some of the agro dealers normally found within rural communities.

Fertilizer: There appeared little concern with fertilizer and it is expected that fertilizer should be readily available. Nigeria, with its major oil industry for which methane, the raw material for nitrogen fertilizers such as urea, can be major flared-off by-product has its own nitrogen fertilizer production. Nitrogen is the major nutrient of concern for rice, primarily because the chemically reduced flooded paddy environment is inefficient preserver of nitrogen fertilizers. Unless ammonia based fertilizers, like urea, are placed in the reduced zone, they will nitrify to the nitrate form, that upon reflooding will denitrify to a gas which will volatize and dissipate. This

could be particularly a problem when the paddy is only intermittently flood as was the case in Kwarre and the reason the farmer was applying frequent low rates of urea. Under paddy conditions phosphorus is normally not a problem as the reduced paddy environment renders Phosphorus more soluble. Thus DAP may not be needed, although any excess Phosphorus applied will simple be banked in the soil and not lost.

No mention was made of concentrating on organic fertilizer. This can be a problem as typically there is just not enough organic sources of nutrients to support commercial crops, nor is there sufficient labor to accumulate and redistribute it. All this before considering the slower anaerobic decomposition and mineralization release rates expected under reduced paddy conditions, as well as the extra organic matter providing the substrata for the anaerobic microbes to increase the degree of reduction, perhaps to toxic levels limiting the availability of Zn and S.

Crop Protection: Crop protection did not appear a concern as both pesticides and herbicides appear reasonable available, although most of the weeding appear to be done manually. However, it might need a word of caution in using pesticides, as the use of pesticides to control insects on rice may be counterproductive as indiscriminate insecticides will kill the natural insect enemies more than the pest. The desire is for patience to allow the natural enemies to respond and control the main pests. This is a process that could take a couple generations of both pest and control insects, with each generation taking approximately one month.

Harvest: This is where the main concern shift from producing the crop to maximizing the recovery and assuring a quality product moving up the value chain for processing and ultimately consumption. The concerns at harvest are first minimizing the amount of paddy abandoned in the field from incomplete threshing, shattering and pre-harvest losses due to rats, bird and insects and second preventing contamination from stones and mud clods that will ultimately have to be removed, or face a 10% or more discount on the sale price. The underlying problem is that with manual harvesting using a sickle or other type of knife, it is usually necessary and expedient to lay the cut shafts of paddy on the moist soil until labor crew member and pick them up and take them to the threshing areas. This provides an opportunity for the grains to pick-up mud clods and possible some small stones, that ultimately have to be removed to avoid the consumer biting on them. In all probability the farmers are fully aware of the problem, but don't have a cost effective means of avoiding it. Unfortunately, the only way to avoid this would be mechanizing the harvest activity with small combines that can cut the shaft, thresh the heads without ever letting the grain touch the ground, and bag the clean grain. Unfortunately**,** that would be difficult in the small paddy areas where IFAD-CBARDP are promoting rice production, unless they have multipurpose small combines that can work both in the paddy as well as upland millet fields, etc. This may be possible and is worth considering. If used only for rice there just would not be sufficient opportunity for the combine owner/operators to meet their expenses. Such small rice specific combines would be more justified in the large irrigated area below the dam in Goyonro.

The actual timing of harvest is a combination of the crops physical maturity after which there will be no additional starch accumulation in the grains, the moisture content relative to the safe storage moisture of 14% and thus the degree of post cutting drying that will be required before the crop can be secure, access to necessary drying facilities to make certain it can be dried before spoiling, and potential pre-harvest losses from shattering, insects, rats, birds, etc., as well as the need to arrange any hired labor for harvesting. Typically without these pre-harvest loses the crop will dry faster left in the field than after it is cut and stacked which limits the air flow for drying. In the Kwarre area visited the crop was approaching harvest and had just reached physiological maturity, but not fully senesced thus the moisture content could be approaching 30% and if cut will need to be dried fairly quickly. However, they do appear to have bird problems and were actively trying to snare some of the grain eating birds.

Threshing: This is again mostly done manually by whacking the rice against some hard object, such as the whacking boxes used in Ghana (Fig. 19), so the grains scatter and are caught in some container or just on a woven mat. Normally, depending on what is used, it does not excessively increase the amount of foreign material such as stones and mud clods in the paddy, but it will still contain appreciable amounts of chaff and empty grains that will need to be winnowed out. However, most whacking threshing operations will leave 10 to 15% of grain behind with the straw and provide an opportunity for gleaners to rework the straw to recover the remaining grains (Fig. 20). This is a very difficult means of obtaining a few kilos of paddy. There are small mechanical threshers that can effectively recover this grain. The most noticeable are the IRRI designed axial flow threshers (Fig. 21) . As an IRRI design the blueprints are in public domain and can be copied by any local fabricator without patient violations[10]. Such machines would be worth introducing to the small rice area that IFAD-CBARDP is promoting rice as well as some of the larger rice producing areas. These

Fig. 19. Whacking ox Used to Thresh Paddy in Ghana.

Fig. 20 Women Gleaning Rice From Remains After Manual Threshing in Ghana

[10] The blue-prints for IRRI threshers are freely available by simple writing IRRI at IRRI@CGIAR.ORG

threshers should not increase the amount of foreign material in the paddy, and should assist with the winnowing operations, possible avoiding the penalty for poor quality grain.

Fig. 21. IRRI Designed Axial Flow Thresher That Can Expedite Threshing and Increase the Recovery.

Drying & Winnowing: Drying and winnowing tend to be a combined operation often taking place on drying floors and often done by women (Fig. 22). These are usually paved areas set aside for farmers to spread and dry their paddy. In the Philippines villages they often attach a basketball hoop to one side to double up as a recreational area resulting in basketball becoming the national sport of the Philippines. The drying floors tend to be shared by several farmers each with their own stack of bags to be spread and dried. There are really two activities taking place. The first is drying the paddy to a safe storage moisture level of approximately 14%. If stored with more than that moisture the paddy may mold. Drying is done by spreading the paddy across the pavement, preferable on a protective mat, and occasionally stirring it so the sun will dry it evenly. However, if only on the pavement, the paddy as an additional opportunity to collect some contaminants such as sand and other stone particles. While there are mechanical forced air driers, they add substantially to the costs and could easily raise the production costs of the final product above what the impoverished Nigerian public can afford. There have been many efforts at promoting mechanical drying for smallholder rice areas, mostly trying to use solar energy; however, they have rarely gotten beyond the NGO promotion and distribution with limited commercial acceptance or sales and probably should not be extensively pursued.

Fig. 22. Communal Drying Winnowing Floor in Ghana

As the crop becomes dry and ready for storage, there is usually an attempt to winnow out the light weight foreign material mostly empty grains, chaff, etc. This is typically done by women pouring the paddy from some convenient height and allowing the wind to blow the light material way. While this can remove most of the light material it cannot remove heavier items such as stones and mud clods as they continue to remain with the full grains. Also, on large communal drying/winnowing floors the winnowing may do little more than move the light material from one person's drying area to the next downwind person's area (Fig. 23). Thus it is unlikely the

manual wind winnowing will bring the paddy up to the desired international standards that would prevent buyers from downgrading the paddy. It may be possible to introduce mechanical winnowing equipment that could improve the quality of the winnowed paddy (Fig. 24). These are basically manually operated wind machines that blow air through the paddy and the light material blows clear. The manual operation is because it is difficult to gear an engine low enough to prevent considerable good grains from being blown away with the light material. While the machines are simple, they would be difficult to justify for individual smallholder rice farmers. They could be inserted into the process at either the winnowing floor preferable at the downwind side, although the ownership lender situation may need to be defined. Perhaps it would be better to insert it at the village buyer that is accumulating paddy for sale to the transporter. That is where the greatest vested interest is in having an initial clean bag of grain as the initial value added[11]. If a couple screens were added, the upper one to catch large material and the lower one to allow fine sands to pass through while retaining the whole grain, then instead of just winnowing, they could also remove most of the stones or other heavy foreign materials. This would most likely now require a small engine to power it and some careful adjustments by the operator.

Fig. 23. Winnowing in Communal Areas May Simply Move Chaff from One Pile to Another

Fig. 24. Simple Manually Operated Winnowing Machine That Can Improve the Quality of Paddy.

<u>On-Farm Storage</u>: The final phase of the rice production would be the on-farm storage of the dried and winnowed paddy. This is a component that may be under appreciated by the development community including host country officers, expecting farmer to market their paddy shortly after harvest. However, the farmers tend to retain their paddy in-kind as long as possible and market only as they need the cash for whatever purchases they need and with the stack of 80 to 100 kg bags consuming a substantial portion of their small home floor space (Fig. 25). This could be part of a reasonable well considered financial management strategy[12]. However, it does prolong the buying season for several months after harvest increasing the overhead costs for

[11] http://lamar.colostate.edu/~rtinsley/CleanBag.htm
[12] http://lamar.colostate.edu/~rtinsley/FinancialStrategy.htm

Fig. 25. Rice Paddy Stored At Home Occupy Considerable Space in Madibira, Tanzania.

organizations buying paddy from farmers or accepting paddy on consignment. It also subjects the paddy to post harvest losses from weevils and rats. However the farmers appear a lesser concern with post-harvest losses than someone removing cash from proverbial cookie jar. Typically, you can expect to store paddy for three months or three generations of weevils before the infestation become noticeable enough to degrade the quality of the paddy and decrease the value. However, it is also possible to chase the weevils away with some simple redrying in the sun (Fig. 26). When laid out on mats or woven winnowing trays the weevils will become uncomfortable with the heat and seek the shade under the mat, allowing the owner to recover the paddy reasonable free of weevils, for another couple months.

Fig. 26. Redrying Grains Can Be an Effective Means of Controlling Weevils as Shown By This Women from Viet Nam.

Concern could be expressed about the use of large 80 to 100kg bags. These are heavy bags that require at least two people to handle and could result in frequent muscle strains by porters, a truly impoverished group of people who cannot afford to miss a few days of work due to muscle problems. The bag weights are really only a close estimate and represent more of a volume measurement than a weight measurement as few bags ever see a scale.

Rice Value Chain – Processing

In Sokoto State virtually all paddy goes through two processes, parboiling and milling. These are typically done in the same community but separate from the production communities. The processing was visited in Kalambaina not far from Sokoto. Here there was one new Sakata Style Single Pass two stage mill, several single stage mills and several parboiling operations. The new Sakata mill was not operating when visited and it was necessary to chase down the key to enter. The housing for the mill was also poorly designed or the mill poorly installed as both fans discharges, one for chaff and the other for hulls, discharged against a wall instead of directly outside. This would build up the dust in the building and make it uncomfortable to work in. Also, the de-stoner was directly connected to the mill in such a manner that it would be difficult to by-

pass the de-stoner to mill some clean bags of paddy that did not require de-stoning. The single stage mills were considerable more active, as were the parboiling operations.

Parboiling

Parboiling is a process of soaking, briefly heating, and drying paddy before it is milled. The process swells the grains, loosens the hulls, and toughens the grain. All this allows for a substantial increase in milling recover from about 67% to 75%, something that is appreciated by government officials in some countries like Sri Lanka trying to promote food security and minimize imports. Also, during this process some of the nutrients in the bran will leach into the endosperm providing for a somewhat more nutritious final product. This is enough to refer to parboiled rice as enriched rice as in Uncle Ben's, but normally not enough to be a major determining factor in the choice to buy parboiled instead of raw rice (Table 4). This is most noticed in the additional amounts Calcium, Phosphorus, and Potassium as well as the vitamin Niacin and the Amino acid Proline while containing less Sodium. In addition the leaching of nutrients from bran to endosperm imparts a slightly yellow color to the final pre-cooked rice product. The grains are also harder than raw rice providing a less sticky texture on cooling that some people object to.

Table 4. Comparsion of Nutrient Value for Par-Boiled vs. Raw Rice per 100g

Nutrient	Unit	Par-Boil	Raw	Nutrient	Unit	Par-Boil	Raw
Proximates				**Lipids**			
Water	g	9.9	11.6	Saturated	g	0.3	0.2
Energy	kcal	374.0	365.0	Monounsaturated	g	0.3	0.2
Protein	g	7.5	7.1	Polyunsaturated	g	0.3	0.2
Total Lipid	g	1.0	0.7	**Amino Acids**			
Ash	g	0.7	0.6	Trypotophan	g	0.1	0.1
Carbohydrate	g	80.9	80.0	Threonine	g	0.3	0.2
Fiber	g	1.8	1.3	Isoleucine	g	0.3	0.3
Sugar	g	0.3	0.1	Leucine	g	0.7	0.6
Minerals				Lysine	g	0.2	0.3
Calcium	mg	71.0	28.0	Methionine	g	0.2	0.2
Iron	mg	0.7	0.8	Cystine	g	0.2	0.1
Magnesium	mg	27.0	25.0	Phenyalanine	g	0.4	0.4
Phosphorus	mg	153.0	115.0	Tyrosine	g	0.2	0.2
Potasium	mg	174.0	115.0	Valine	g	0.5	0.4
Sodium	mg	2.0	5.0	Histidine	g	0.2	0.2
Zinc	mg	1.0	1.1	Alanine	g	0.4	0.4
Manganese	mg	1.0	1.1	Aspartic Acid	g	0.8	0.7
Selenium	mcg	19.9	15.1	Glutamic acid	g	1.4	1.4
Vitamins				Glycine	g	0.4	0.2
Thiamin	mg	0.2	0.1	Proline	g	0.8	0.3
Raboflavin	mg	0.1	0.0	Serine	g	0.4	0.4
Niacin	mg	5.0	1.6				
Panthothenic acid	mg	0.7	1.0				
Vitamin B-6	mg	0.5	0.2				
Folate, total	mcg	8.0	8.0				
Vitamin E	mg	0.0	0.1				
Vitimin K	mcg	0.1	0.1				

In Sakoto State, as in the rest of Nigeria and other parts of West Africa, parboiling is done mostly as a village family enterprise. The process usually involves soaking the rice overnight, in large vat, often adapted from 42 gal (160 lit.) oil barrels (Fig 27). After soaking the paddy is heated over an open wood fire until it starts to boil, and then stopped, cooled down and dried back to a storage moisture level. While filling the vat for soaking many of the empty grains will float to the surface, and can be easily skimmed off, also the mud clods can dissolve and sink (Fig. 28) Thus, the parboiling process can increase the quality of the rice by removing some of

Fig 27. Paddy Soaking in 42 gal (160 lit) Barrels Used for Parboiling

the remaining foreign material. Since heat is applied only to the bottom of the vat, and there is limited provision for stirring the rice during the heating, it is suspected that the heating and thus parboiling is uneven. However, this may not have a major impact on the final quality as there is no major color or consistence differences between local parboiled rice and USA or Thailand sample used in an early assignment (Fig. 29). The Nigerian Parboiling appears whiter in color perhaps indicating lower degree of heating, but consistent throughout which is probably more important to quality and market value.

Parboiling as practiced as a village based value added family enterprise tend to be fairly labor intensive. Thus, it unlikely that farmers will have the time to become directly involved other than as occasional casual laborers when there is no pressing work on their respective farms or there is a short term critical need for cash. When processing as a casual laborer they will most likely be working with someone else's rice and not their own. Thus paddy processing is mostly out-sourced and most likely will remain such.

Fig. 28. Stirring Paddy to Help Separate the Empty Grain So They Can be Skimmed off and the Clods Dissolved and Sink

A major women's health concern was expressed about parboiled rice as done in Nigeria and other parts of Africa from the long term exposure to smoke. It was mentioned that women, who mostly attend the fires, will start to lose their vision

Fig. 29. Visual Comparison Between Parboiled Rice in The USA, Imported From Thailand and Produced in Nigeria.

and be virtually 100% exposure Tuberculosis by the time they reached 40 years old. This has to be recognized as a chronic health issue that materializes with long term exposure taking place in a short term economic environment. Thus preventative measures will be difficult to undertake when profit margins are small so short term returns take president over long term health. There are reports of improved parboiling vats available in Nigeria promoted by some NGOs. These vats supposedly have enclosed fire boxes and chimneys that can safely disperse smoke above the workers heads. However, given the short term economics, it will be difficult to get them accepted for health concerns. Perhaps the best incentive for using them would be they are reported to consume only half the amount of fire wood. This would provide a direct financial benefit in terms of less wood to purchase as well as the time needed to procure the wood. A benefit with the desired short term returns conducive to the economic environment (Fig. 30). Obtaining such vats should be considered and perhaps some micro-financed obtained to assist parboilers to purchase them, but promoted more for the environmental sustainable wood saving than reduced health problems.

Fig.30. Large Supply of Firewood Needed for Parboiling for Which the Long Term Exposure to the Smoke Leads to Serious Health Problems

Another possibility might to look at propane as a possible energy source for rural areas, including parboiling and general cooking, etc. Iraq, which has a similar economy to Nigeria where a substantial petroleum industry does not appear to benefit the population at large, appears to have promoted propane for rural affordable energy.

This then had a side benefit for reforestation programs, with reduced premature cutting of trees for firewood. This might require some high level policy adjustments to make propane easily affordable and available to the rural population. It might also require encouraging some NGOs to design propane burners suitable for parboiling with the vats commonly being used.

Milling

The second process is milling to remove the hull and bran that produces the final polished rice consumer product. This is typically done in the same community as the parboiling, and may be mostly on contract instead of consignment or purchase basis. It may also include a cleaning or de-stoning process to remove any remaining stones. If done, de-stoning will be just prior to milling and perhaps in a continuous flow with the mill. It should be noted that any mechanical de-stoning at this point will result in loss of some good grain. Thus even if there is only two or three percent stones and mud clods, the de-stoning process will result in up to 10% loss in paddy. This again has to be factored into what the farmers can receive for their paddy. There appear to

be two types of mills used in Nigeria for milling rice. One is a single stage mill and the alternative is a two-stage mills that are just being introduced.

Single Stage Mills: The most common mills are single stage mills that attempt to remove both the hulls and bran in one operation. This is basically the rasp bar or second stage of the two-stage mills (Fig. 31). They are simple, most likely cheap, but inefficient mill that results in a high number of broken grains even after parboiling, as well as a low total recovery. The broken will typically be over 15% (Fig. 32), and the recovery about 50%. The amount of broken would most likely represent the 10% grade on the Thai quality scale (Fig. 5). These mills can never be adjusted or millers trained to provide substantially higher quality rice, and can persist only for providing cheap low quality rice at best. Even that may be questioned as the increased recovery from two-stage mills should cover the extra cost for buying and operating the mills. The waste from these mills is a finely ground mesh composed of hulls, and bran. However, it must contain considerable amount of finely ground up grains of rice, but this is not apparent from a visual inspection of the mesh. It may have some potential for animal feed if used fairly quickly after milling before the oil in the bran become rancid and if the silicon in the hulls doesn't injure the animals[13].

Fig. 31. Single Phase Mill Used for Rice But With Only 50% Recovery and Excessive Broken

Fig. 32. Physical Separation of Head Rice From Broken and Other Material for Rice Milled In Single Phase Mill.

Two-Stage Mills: The two stage single pass mills are not presently common in Nigeria, but are popular in other parts of the world for local village milling. The most common is the Sakate style mill (Fig 33). This may have originally been a brand name but has evolved into specific style of mill. With the two stages the paddy is first passed through a set of roller that removes the husk which is then blown free (Fig. 34). The second stage is a rasp bar drum in which the de-

[13] Rice Bran contains about 20% oil of moderate quality comparable to soybean oil. It can be extracted as editable oil but needs high volume of rice to be commercially justified. Thus only in Thailand is rice brand oil widely used as editable cooking oil. However, is is enoudh to be a concern when rice bran is used for feed and either has to be used quickly or heated to fix the avoid the bran from becoming rancid. Likewise, rice hulls contain large amount ofo sicica that can injur animals throught when consumed.

hulled rice is injected into the center. As it passes through the bran is rubbed off and drops through the grid to be collected and hopefully used as a quality animal feed, again with concern for the oil becoming rancid. Such mills can produce an acceptable quality of rice with 12% or less broken grains, but not up to international standards (Fig. 35) and would be classified as 5% by Thai Standards (Fig. 5). This would most likely satisfy local consumption needs and compete favorable with the imported rice. The Sakate style mills also can increase the rice recovery to 75% for parboiled paddy. This represent a 50% increase in recovery compared to the single stage mills and should justify the extra cost independent of the improved quality. Thus there should be no increase in the final consumer price.

Fig. 33. Recently Obtained Sakata Two Phase Mill (Right) with De-Stoner (Left) in Kalambaina, A Rice Processing Community Near Sokoto

Fig. 34. Sakata Two Phase Mill Showing Roller Bars for Dehulling & Rasp Bar Drum for Polishing

Both of these mills are designed for low capacity in the order of 300 kg per hour. As such they are highly suited for the small family enterprise system that dominates the commerce of countries like Nigeria. Also, neither is capable of meeting international standards for milled rice at the Thai 100% grade. To reach this standard requires higher capacity more sophisticated mills. These are generally in the three ton per hour or more range, with the third stage being a sieve to remove all broken and tips.

Fig. 35. Physically Separated Head Rice & Broken From Sakata Mill

Rice Value Chain – Marketing

The final component of the value chain is the marketing to the consumers. Once processed, the milled rice will be delivered to the wholesale market in the major cities where the various wholesale dealers receive and distribute whole 100 kg bags of rice (Fig 36). The individual wholesalers' initials are clearly marked on each bag (Fig 37.). Each dealer will handle from 10 to 15 of the 100 kg bags of rice. Thus, even when the

Fig. 36. The Rice Wholesale Market In Sokoto.

shipment from the processors is a full 10 ton lorry containing 100 of the 100 kg bags, it will represent the consolidation of several wholesalers. From the wholesaler most of the rice will be sold to the retail vendors who usually deal with a variety of dry goods such as rice, millet beans etc. They will typically buy one to three bags of rice; transport them to their various stalls to be displayed in large pans along with the other grains through the open air market (Fig. 38). This is all marketed to the consumer by a standard volume locally know as a mudu that holds an estimated 2.5 kg depending on the density of the goods being measured. Most vendors heap the mudu and toss in a little extra for good measure. There are also smaller measures used for goods that are not in high demand, or for people only needing small quantities. In the entire market chain virtually everything is handled by volume with standard measuring devices. Very little is actually weighted although most people have a fairly accurate idea of weight.

Fig. 37. Bags Of Rice Marked With Individual Wholesalers Initials

Fig. 38. Open Air Retail Market for Bulk Rice and Other Grains.

In addition smaller amounts of rice are marketed through the supermarkets and convenience stores. This is all packaged into plastic or stitched bags. Some of this is for specialty markets such as imported basmati or brown rice, sold in small bags of 10 kg or less (Fig. 39). This caters to people who are not using large quantities of rice but can afford to purchase imported rice. There is also imported rice mostly from Thailand or India (Fig. 40). This is parboiled jasmine rice that is bagged in 25 kg bags.

There may be a potential for packaging local rice for supermarket sales, but it has to be done with a careful analysis to make certain the extra added value is greater than the added costs. This

Fig. 39. Examples of Speciality Rice Found in Sokoto Supermarket, Including Thai Jasmine, Indian Basmati & Calfornia Brown.

most likely would be done at the processing communities or by large farms such as Olim in Banue. It is unlikely smallholder farmers will become directly involved. Other then if Olim develops out-grower programs to bring smallholder farmers into their marketing system. This is something worth considering and encouraging.

Fig. 40. Retail Stall for Imported Rice From Thailand & India.

The prospects for small volume packaging into one or two kilo packs may have problems with the small convenience stores as they may opt to undertake this value added directly reducing the demand from a farmer involved value chain. For example a convenience store operator in Kenya would purchase the 100 kg bulk bags of rice from wholesalers for KSh 8000 (KSh 80/kg). Then repackage it into one kg plastic bags and sell them for KSh 106/kg. This represents a 33% mark-up. However, the mark-up has to include transpor-tation costs for the 100 kg bulk bag from wholesale area to store, the cheap plastic bags at KSh 40/100 bags. As the rice was now going directly to the consumer with no intermediate handling the owner could justify cheap bags, and since this was done during lulls between customers, the labor would have no marginal costs. The repackaged rice would than be subject to the normal retail mark-up to cover the owners overhead costs and salary[14]. This could difficut to compete with.

Linking The Value Chain

Linking the production, processing and marketing components of the rice value chain are a group of “middlemen” that can be much maligned as exploiting the smallholder farmers, but such commentary is usually made without any supporting analysis. Without any supporting analysis any maligning commentary could represent slander with the entire legal ramification implied. Nor does such commentary note some of the essential contributions middlemen make to the smooth flow of the value chain. It also has to be appreciated that the current value chain was spontaneously developed within the private sector in response to business needs of the various components including the smallholder producers. The whole value chain is operated through the

[14] Personnel Communication: Eunice Mwaura

family enterprise system that dominates the commerce of Nigeria and most countries in the developing world.

Family Enterprise System

Business in Nigeria and most of the developing world is dominated by a multitude of small family enterprises. Perhaps the most illustrative of which is the Talid Thai wholesale market that serves Bangkok, Thailand. It is spread over a couple square kilometers with four large warehouses. However, on closer examination everything is broken down into small sections of 10 x 20 meters, each with its own processing facility and living area equipped with sofa, TV etc. These are all small family owned and operated business renting their space from the Government that operates the market. Within the Talid Thai market each family enterprise commands a limited market volume, perhaps a pickup truck or two per day. These enterprises are assisted by some very causal laborers, often piece meal porters paid per bag they handle. For some reason it appears difficult for most enterprises to become more than a family operation. Perhaps, in the overall suppressed economy with many people living on the margins of survival, the temptation for pilferage to gain just a temporary advantage is too great. Thus all casual laborers have to be closely supervised by someone with a vested financial interest in the business, thus a family member.

This results in a highly fragmented business operation[15]. Such fragmentation may be good for competition that would favor the smallholder farmers, however, the smaller the market volume the greater the individual mark-up for services provided to assure the business does not fall below the poverty line, as shown by banana trader from Uganda or tomato vender in Zambia[16]. Also, even though fragmented into a multitude of family enterprises within each component the various people involved normally operate in close proximity to each other are well known to each other, and cooperate as needed to allow a smooth business environment.

In Nigeria the family enterprises involved in the rice value chain would include:

- The farmer
- Any contract mechanization people suppling tractors or other forms of mechanization
- The agro-dealers providing inputs
- The agro-dealers buying the produce
- The transporters that take the paddy from farm community to processor and again to the wholesalers
- The rice processors for parboiling and milling
- The wholesale dealers

[15] http://lamar.colostate.edu/~rtinsley/Private.htm
[16] http://lamar.colostate.edu/~rtinsley/BananaTrader.htm; http://lamar.colostate.edu/~rtinsley/TomatoVender.htm

- The retailers

Links in Rice Value Chain

Farmer: The first link in the rice value chain is the farmers. They also represent family enterprises in the business of producing rice along with other crops. They are the intended primary beneficiary of the value chain evaluation.

Village Buyer: The second link is the agro-dealers who serve as the village buyers. Their task is to accumulate enough bags of paddy to justify a trader coming to collect it (Fig. 41). Typically traders are interested in picking up a whole lorry load at a time. For a 10 MT lorry this would mean approximately 100 bags of 100 kg each. Traders are not interested in traveling several hours to pick up a smaller amount, and they are not interested in coming to a community and waiting around for the farmers to bring their bags to them. They are anxious to deliver the paddy to the processors and return home, and it will take considerable longer returning with a full lorry. Likewise the farmers are not interested in breaking away from their day's activity when a lorry suddenly arrives to buy paddy. Thus the village buyers are a good go between for both the farmers and traders. They are also indigenous to the community they serve and thus working with friends and neighbors.

Fig. 41. Village Rice Buyer Consolidates Rice For Trader to Make Weekly Pickups in Adamawa, Nigeria

Fig. 42. Grain Spike (Thief) Used to Check Quality in Bags Of Any Grain

The village buyers may be the best place to insert a winnower/grain cleaner. They have a vested interest in selling to the traders the best possible paddy as the first value added[17]. Thus, if they had a grain cleaner, farmers could bring their paddy in run it through the cleaner, with the expectation of commanding an additional 10% value or a reasonable part of it. The quality can be checked at this point or any point in the chain with a simple grain spike or more formally called a grain thief (Fig. 42). These spikes can be inserted through the weave of the bag so a sample can be withdrawn and checked for quality in terms of amount of

[17] http://lamar.colostate.edu/~rtinsley/CleanBag.htm

chaff, unfilled grains and foreign material, without substantial damage to the bag that would allow large amounts of spillage. The village buyers tend to operate in the open without and shelters to protect the purchased grain other than a canvas tarp in the evening along with a shared security guard, a business model that substantially reduces overhead costs. Typically there would be several of these village buyers in a community providing options for different farmers (Fig 43).

Fig. 43. Multiple village Buyers Available to Purchase Rice From Farmers in Adamawa, Nigeria

Also, they would be in business for most of the year as farmers gradually bring their produce to be marketed over time and they need the cash. Figure 41 and 43 were taken some five months after harvest with an ample supply of paddy for the buyer expected for at least two more months before any shortage are expected. In addition, if necessary, these village buyers could deal in all the commodities being produced within the community, be that rice, millet, cowpeas, etc. In dealing with multiple commodities they would be spreading their overhead costs over the different commodities which would provide a competitive advantage to program dealing with only a single commodity like rice. While the example is from Nigeria, similar situation occur in Malawi and most countries in Africa.

Traders/Transporters: The third link in the value chain is the traders/transporters that move the paddy from the village where it was produced to the processing community that will parboil and mill it (Fig. 44). These are mostly independent lorry owner/operators working on contract to the wholesalers or other member on the value chain. They really have little interest in the paddy or milled rice, other than to move it from point A to point B. They could represent several wholesalers or be accompanied by a representative of the wholesalers. They come to a producing community when there is sufficient paddy to purchase, buy the paddy, hire some porters to load the truck and depart as expediently as possible. If working for a group of wholesalers, they will be provided a buying float to purchase the paddy. They then off load the paddy at a processing community, finished. They then depart for home leaving the buyer to remain with the paddy while it is processed. They will charge a flat MT/Km rate for

Fig. 44. Typical Seven Ton Lorry that Brings Paddy from Farm Community to Processing Facility

their services, adjusted for the distance on or off the tarmac with off tarmac being as much as triple the tarmac rate.

Processors: The forth link in the value chain is processing. This appears to be done mostly in communities that specialize in parboiling and milling. These are two independent activities that are rarely consolidated into one. The parboiling appears to be mostly on consignment while the milling is mostly on contract (Fig. 45). This basically reflects the time to complete the task and prospects for the owner to continuously observe and supervise the process, with the parboiling taking two day and the milling a matter of hours. Like the rest of the value chain the processing, both parboiling and milling is done by a large number of family enterprises each handling a few bags at a time. After milling the rice is bagged in 100 kg bags marked with the buyer initials and prepared for shipment to the wholesale market. During milling there will be a 30% to 50% reduction in volume associated with the removal of hulls and bran so the second transported can be a considerable smaller vehicle.

Fig. 45. Processing Facility To Process Paddy to Parboiled Milled Rice

Transporter: The fifth link is like the third, transporting the now milled rice to the wholesale market. This again is done by contracting a lorry to pick up the labeled bags and deliver them to the wholesale market in major cities such as Sokoto. These lorries normally will travel fully loaded, and thus be transporting the milled rice for several wholesalers. This is very similar to the market channel for other commodities in developing countries as highlighted in the MSc thesis on marketing tomato in Nepal[18].

Wholesale Market: The whole sale market is normally in a centralized area in the city where all those dealing with whole bags of rice met, off load their lorries and sell rice do the retailers (Fig. 46). Typically the wholesalers will deal in 10 to 15 bags of rice. This is done for whole bags with possibility of checking the quality with a grain spike. Typically sales are for only two or three bags with the buyers responsible to transport the

Fig. 46. Group of Rice Wholesalers Waiting for Customers

[18] http://lamar.colostate.edu/~rtinsley/Private.htm

bags to their respective stall or retail area. While they are independent family enterprises they tend to friends and provide assistance to each other as needed.

Retail Market: The retail market is the final link in the value chain and where people come to purchase rice (Fig. 47). Mostly this is open air and involved retailers selling a multitude of dry good commodities from large open pans. These sales are by volume with an estimate kilogram value.

Fig. 47. Retail Seller of Rice Along with Other Grains and Beans, Etc.

In this early 21th Century the whole value chain is coordinated through cell phones for which virtually every link as at least access to, if not direct ownership, including most smallholder farmers.

Enhancing the Rice Value Chain[19]

Enhancing the value chain for the primary benefit of the smallholder producers could be a real challenge as it has to be recognized that the current value chain was developed spontaneously over time to accommodate various needs. It was developed by the private sector with a profit motivation in a financially suppressed environment which limits what an impoverished consuming public can pay for food including rice. Thus profits are mostly derived from keeping overhead costs as low as possible. Thus it would be incorrect to assume that any social desirable farmer owned and operated business models can effectively compete with the current value chain.

Considerations in Enhancing the Rice Value Chain

Farmers' Involvement & Costs of Doing Business: Perhaps the first concern in enhancing the value chain for rice or any other value chain commodity for the benefit of smallholders is how far up the value chain should the farmers be directly involved. There are really two issues; one is financial and other convenience. Financially, as one become more involved up the value chain there will be an increase in the value of the product such as rice. However, there will also be an increase in costs associated with obtaining the added value. Thus, the question when will the additional costs exceed the increased value. If this happens it will be financially better for the farmers to hand off the value added to others. The next issue is convenience, and the farmers' interest in dealing almost exclusively with cash transactions. Much of this reflects a financial management strategy of holding goods in kind as long as possible then marketing only what is

[19] While the scope of work for this assignment specifies developing work plans, it is really inappropriate for a consultant to do more than simply suggest what should be considered in developing work plans. It is then up to the host to incorporate those suggestions into a final work plan.

needed to meet immediate cash requirements[20]. In this case cash payments are a critical part of the overall strategy. Thus consignment selling will quickly become inconvenient and farmers will divert goods back to the family enterprises. This problem will become more acute if payments are delayed as the product is move further up the value chain before receiving payments, which will take additional time and delay payments. Thus it is unlikely farmers will have a substantial interest in active involvement up the value chain beyond the initial sale to the village buyer. Insisting on involvement above this point could minimize the volume of goods being processed and thus ultimate farmers' appreciation for the effort. If this becomes too inconvenient the farmers will divert most of their business back to the family enterprises and project will ultimately have negligible impact of poverty alleviation, as appears to have been the historic case.

After Farmers' Turnover: Above the point in the value chain where the farmers have sold their produce, improving the value chain can still have a positive impact on the farmers. Certainly, improved feeder roads that will reduce transportation costs will immediately impact remote farmers as they have always had to adsorb the extra transport costs as a deduction on what they receive. Also, improved milling recovery and quality of milled rice could increase the amount of harvested rice reaching the market and thus the total returns the dealers receive allowing them to pay the farmers more. In addition, with improved quality the demand for local rice as opposed to imported rice should increase resulting in more demand and higher farm gate prices. Some of this might be trickle down and trickle up economics but will fairly quickly impact on the smallholder rice producers.

Using Farmer Organizations: When undertaking a detailed "costs of doing business" comparison between the current value chain and any proposed modifications, there is a need review the historic sustainable contribution of farmers' organizations. While farmers' organizations, such as cooperatives, maybe socially desirable and have been the primary mechanism for development projects to funnel assistance to smallholder for a few decades, a closer examination may indicate they are more scandal than effective tool for poverty alleviation even in this the UN proclaimed year of the cooperative. For over 20 years the development community has promoted cooperatives for their potential to negotiate volume discounts on inputs and bulking produce to command a higher volume sales price. While this is true for cooperatives, the same as any other volume dealer, the questions remains, can cooperatives, as modified and imposed by development projects, deliver these negotiated benefits to its members or are the underlying mandated cooperative business model just too administratively cumbersome so the sustainable overhead costs[21] consume all the negotiated benefits, and is the

[20] *http://lamar.colostate.edu/~rtinsley/FinancialStrategy.htm*

[21] *The sustainable overhead costs would be the costs to operate the cooperative without any external assistance in terms of subsidies and advisory input. Basically, it would be the local hired costs in terms of employees including*

business model too inconvenient to compete with the family enterprise system. Thus they ultimately attract few **active** members, and even those members wisely divert the majority of their business to the family enterprises, resulting in the cooperatives attracting too small a market volume to make any inroads into poverty alleviation for the communities they claim to serve.

This is then covered up with some massive spin reporting aimed at appeasing the donors to provide good publicity opportunities and assure contract extensions and future contracts, while doing little for the smallholder producer[22]. Typically the spin reporting is done by keeping numbers in the aggregate, which may appear impressive, but in reality represents trivia. Alternatively, stop the accounting at the cooperative which allocates all the costs associated with operating the cooperative as a direct financial benefit to the farmers. An example would be the fair trade coffee cooperative in Ethiopia[23] that boasts 21,900 members and marketed some 181 MT of coffee. Divide it out and it represents only 8.3 kg/member and corresponds to maybe 5% of the coffee produced by the members. At the favorable price differential for fair trade coffee relative to the open market the total financial benefit might be US$ 5.00/member. It is hard to see that having any real impact on poverty alleviation. If the farmers are only committing 5% of their produce for Fair Trade, are they really interested in the program and what happened to the rest of their coffee?

In another example Sustainable Harvest (Fig. 48) again for Fair Trade Coffee reports stops the accounting of benefit at the cooperative. Here the US$1.55/lbs claimed to go to the growers, most likely went to growers' cooperative upon delivery to Sustainable Harvest. To get what the growers actually received it would have to be backed up for the transportation costs between community and Sustainable Harvest warehouse, any processing costs done by the cooperative such as converting parchment coffee to green bean, than the overhead costs for operating the cooperative, and since this is Fair Trade the social tax. Of the US$1.55/lbs proclaimed as the growers share they would be lucky to receive US$1.00/lbs.

Fig. 48. Bag of Sustainable Harvest Fair Trade Coffee Showing Allocation of Consumer Price to Different People Including the Growers, but Is This Really What the Growers Receive?

Excluded from the reporting is the fundamental business parameter that would determine, not only the ability to recruit members but, the extent the members are relying on the cooperative for

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salary and fringe benefits, operating and maintenance of physical facilities as well as vehicles including lorries for transport, etc. Typically the sustainable overhead runs 30 to 35% of services provided.

[22] http://lamar.colostate.edu/~rtinsley/DeceptiveReporting.html

[23] http://www.uwcc.wisc.edu/info/intl/ethiopia.pdf

the services they require vs. how much they are side-selling to the family enterprise system[24]. The missing business parameters include:

1. Comparative costs of doing business between proposed and current value chain,
2. Overhead costs of operating the proposed value chain, including any surcharges, commissions etc. charged by the cooperative to the members
3. Active membership as percent of potential beneficiaries,
4. Percent of side-selling of goods obligated by by-laws to the proposed value chain but diverted to the family enterprises
5. The actual financial benefits received by the members
6. Payment of promised dividends, as normally defined.

Other than the basically financial business concerns mentioned above, are the intangible concerns of convenience in a cash based society that retains good in-kind as long as possible as part of reasonable well considered overall financial management strategy, but requiring immediate cash payments.

It is possible to list numerous areas where the imposed cooperative business model can quickly lose the envisioned competitive advantage to the more cost conscious family enterprises[25]. These would include:

1. Administrative procedures
2. Physical Facilities
3. Proximity to Farm
4. Permanent support staff vs. piece meal porters
5. Non-competitive wages
6. Project Vehicles for basic transportation of people
7. Housing and Travel of seconded staff
8. Trucks for hauling goods.
9. Individual commodities vs. multiple commodities
10. Overall Financial Management Strategy
11. Cash Payment
12. Consensus development
13. Social non-business services
14. Pilferage

The result is the cooperative used by development projects require continuous external facilitation and subsidizing to survive and collapse almost immediately once the external assistance ends. Some of the fundamental reasons would be the use of consignment sale with a

[24] *http://lamar.colostate.edu/~rtinsley/InformationRequest-.htm*
[25] *http://lamar.colostate.edu/~rtinsley/LossCompetitiveAdvantage.html*

delayed payment, in a society in which the basic financial management strategy is to hoard goods as long as possible and then sell for immediate cash payment. Also, the use of credit clubs for which a farmers can be responsible for a neighbors defaulting loan. Once farmers have part of their hard earned crops confiscated to pay a defaulting neighbor, they will be very careful in consigning future crops. In this case the astute honest farmers simply consign enough to the cooperative to cover their loans, then side sells the balance. If farmers consign more they risk having part of their crop confiscated to pay off a defaulting neighbor's loan. Both situations encourage farmers to side-sell the bulk of their business to family enterprises as the default service provider. This leaves the development project with too limited volume to have any effective impact on the communities' overall economics for poverty alleviation. The concern for this spin reporting has resulted in an inquiry being sent to the USAID Office of Inspector General[26] with the assistance of Senator Mark Udall of Colorado and assigned case no 12-0189. In reply the Assistant Inspector General for Audit acknowledged the absence of basic business parameters in the reporting, and suggesting it be collected in the future[27]. Hopefully, this will start to have donors reassess the contribution of cooperatives and look for more effective alternative means of assisting smallholder producers.

Adding Value or Out-Sourcing: Another consideration in trying to enhance the value chain is to consider if the farmers, as primary beneficiaries, will be better off becoming involved in value added activities further up the value chain, or concentrating on increasing their production and out-sourcing the value added. The perception that farmers would be interested in active participation in the value added is based on the unsubstantiated assumption that there is a surplus of labor in smallholder communities and farmers can be assisted with labor intensive innovations including value added activities. In this regards it has to be realized and appreciated that the farmers more than likely have limited labor to allocate to various options. Thus the question are farmers better off concentrating on increasing their agronomic output and out sourcing the value added, or actively participating in adding value. For rice the prospects for value added, other than promoting clean bags of paddy for sale to the village buyer, would be the labor intensive parboiling followed by milling.

It appears that farmers often are more interested in out-sourcing the value added and concentrating on their agronomic output. This was readily shown by cassava farmers in Benue. Here a FAO promoted women's income generation project to convert cassava to gari, appears mostly abandoned to the extent it took half hour to obtain the key for a visit (Fig. 49), while across the street and less than 100 m away is a small women managed gari factory operating at 100% capacity (Fig. 50). The couple in charge claimed they produced some cassava, but were basically drifting into the full time processing and buy cassava from their neighbors.

[26] *http://lamar.colostate.edu/~rtinsley/InspectorGeneralUSAID.pdf*
[27] *http://lamar.colostate.edu/~rtinsley/InspectorGeneralReply.pdf*

Fig 49. FAO Women's Income Generation Project For Making Gari That Appears Abandoned.

The same appears to be with rice particularly the labor intensive parboiling. It is highly unlikely that the labor limited farmers will have time for active involvement in the parboiling process. The best that might be hope for would be for farmers, on the rare occasion when they little to do on their farms or have a short term need for cash, to serve as a casual labor for the parboiling processors. This was noted previously in rice processing community in Awka, Amambra State. Thus there might be an advantage to having the rice processing near the rice producing areas so the processing can provide an occasional off-farm income opportunity for the farmers.

Fig. 50. Private Family Enterprise Producing Gari and Full Capacity 100m Away From the FAO Abandoned Project.

Extension Demonstrations: Another concern would be reliance on extension demonstration plots. These are based on the assumption that knowledge is the primary limiting factor in farmers' limited acceptance of recommendations and the farmers have the operational resources readily available to extend the demonstration across the rest of their farm or community once the basic knowledge is obtained. However, while demonstrations make a good show, they really only express the physical potential for maximum yield. They do not factor in the economic optimal yield that is the input level with the maximum return for the investment. They also don't evaluate the drag on the physical potential because farmers are short of labor or access to contract machinery, etc. Nor do they factor in the priority the farmers give to other crops, particularly if the other crops are rainfed and the rice is irrigated. In this case it has to be recognized that if the farmer does not give priority to the rainfed crops, most likely they will be lost, while the irrigations system provides operational flexibility to the rice crop.

Thus, while the demonstrations might provide a good show of the physical potential, there is a need to understand and appreciate the fine tuning the farmers have to make as they integrate the demonstrated technology into their limited operational resource base and other crops as farmers attempt to "maximize their total returns to all their various farm enterprises".

Economics of Mechanization: Some of the prospects for enhancing the rice value chain involved providing farmers or other members of the value chain access to contract

mechanization for such tasks as land preparation, combine harvest, two-stage mills, etc. These machines are too expensive for farmers' direct ownership and thus the import concern is access to the equipment rather than ownership of it. In order for this to be effective it is important to undertake and economic analysis for the equipment and their owner/operators to make certain they have enough economic opportunity to meet their expenses both the initial capital outlay, and continuing operational costs. If not the equipment will go bankrupt and no longer be available or become too expensive that smallholders cannot afford the rent charges. While the complete analysis can be somewhat complex a good starting point would be to assure the equipment can be used for a complete work year. This is normally defined as 220 days. The balance of a 365 day year will be consumed by weekends, vacation time and holidays. Thus if a combine can do 1.5 ha a day, it will need an area of 330 ha to have a complete work year, provided the demand is spread out and not seasonally concentrated. Thus combines would be possible in the fully irrigated areas below the damn, but not in the areas pumping water from shallow wells. Also, the overall suppressed economy limits what farmers can afford to pay for contract mechanized services. This will then impact on the area the equipment needs to work to cover its capital costs including interest, which then restricts the number of tractors that can be supported in a community, and if this becomes too restrictive the time it takes to complete the basic land preparation.

Prospects for Enhancing the Rice Value Chain

The value chain for rice in Sokoto looks very similar to most value chains and market channels that have evolved in developing countries. They were developed as private family operated enterprises[28]. The overall operations appear highly fragmented with each business having only a limited market volume. They tend to be highly efficient businesses with limited profit margins that can deliver goods at affordable prices to an impoverished society. The result could be that enhancing the rice value chain can be fairly challenging. Most likely enhancing the value chain will involve making additional resources available to the farmers and other members.

Production Component: The place to start enhancing the value chain might be at the farm level as this is where the farmers, as the primary intended beneficiaries, have the most direct influence. It is also where there could be the greatest potential primarily by increasing rice production. The suggestions would be:

1. The farmers need to be more serious about rice production. This will require increasing the rice area each farmer has to work. As it is, in all the areas visited, rice was only a small portion of the total farming operation. While it might be socially desirable to involve more farmers into rice production, it reduces the farmers' interest in rice. Thus the farmers rightly concentrate on their other crops. Thus for those areas operating with

[28] http://lamar.colostate.edu/~rtinsley/Private.htm

shallow pumps the farmers should be encouraged to consolidate at least until there is only one farmer per pump. As with all forms of mechanization, shared ownership rarely works particularly after breakdowns become common, repairs need to be made and farmers start squabbling among themselves as who should be responsible for the repairs. Thus sharing of equipment even pumps needs to be on individual ownership and contracting to others as needed. For the large irrigated areas the farmers should be allowed and encouraged to consolidate up to five or six hectares, and thus become full time irrigated rice farmers.

2. Also there may be a need to take a very careful look at the production economics of those areas promoted for rice production using the small pumps to lift water from shallow undeveloped tube wells. Since the pumps have to be run almost continuously at considerable expense to have any expectation of keeping the fields ponded and without continued ponding the yield is only a marginal 2.5 MT/ha these areas may not really be economically suited for rice even though it is physically possible to grow rice with marginal yields. If this is the case the farmers would be better to concentrate on other crops, and most likely will quickly do so.
3. The best prospects for increasing rice production in Sokoto State may be the fully irrigated area. However, this will require allowing for larger holding as mentioned above, and then encourage farmers to invest in individually owned rice power tillers (Fig. 51), complete with rotovators and small trailers (Fig. 52). These originated in Asia and were an unheralded substantial contributor the success of the green revolution in Asia. They are slowly being accepted in Africa. In addition it should be possible to consider encouraging individuals to invest in some of the small combines for making a clean harvest (Fig. 53). These combines again originated in Asia but are making their way to Africa. With larger allocations and good water management, the yield potential should increase from the 3.5 MT/ha to upward of 5.0 MT/ha with full recovery as clean market ready paddy commanding the 10% bonus from the traders.

Fig. 51. Private Rice Power Tiller Being Used In Akusa, Ghana

Fig. 52. Power Tiller With Trailer Used for Hauling Rice from Field To Home In Madibira, Tanzania.

4. Then for the deep water areas subject to flooding to a depth of 1.5 to 2 m, the need will be to investigate the possibility of using deep water rice technology and varieties from Thailand and Viet Nam. This would require an inquiry to IRRI or AfricaRice about having a rice ecologist, with deep water experience visit the areas and appraise the potential, along with other areas of fresh water swamp rice in Nigeria such as the area observed previously in Adamawa, State. This would be an approximately three month consultancy to evaluate the prospects and if favorable to develop a proposal for introducing deep water elongating lines to Nigeria for growing in these areas. This would most likely be a five to ten year project, but could bring some basically unused land into production. It should be noted that deep water rice is casually managed rice that is basically planted and harvested with little if any mid-season cultural practices. The yield is also low around two metric tons per hectare or lower, but it will still be an increase over no production. Initial inquiries to IRRI indicate that IRRI no longer has a deep water rice program, but now recommended most deep water areas plant regular early maturing paddy rice as the flood recedes. Also, Thailand may now have less need for deep water rice as increased flood and water control structures on the Chao Pray River have substantially reduced the area subject to deep flood conditions and replaced it with more normal more production irrigated rice. Obtaining such flood control on Nigeria rivers may take some considerable time.

Fig. 53 Small Rice Combine Recently Acquired In Akusa, Ghana.

5. In all rice areas strive for a mixture of three or four improved varieties. This will assure there will not be a complete crop failure if there is a breakdown in resistance to any pests. Normally, there will not be a statistically significant yield difference between the top performing four or five lines, and the actual highest yielding lines will jump around from year to year (Table 3).
6. Similarly, do not get overly concerned with providing certified seed each season. This can be logistically challenging, and not necessary as a self-pollenated crop rice can retain sufficient genetic purity for several generations away from certification. It might be better to pump small amount of promising lines into rice producing communities and work with some people in the community to multiply and distribute the seed locally[29].
7. Be very careful in promoting farmer organizations for providing business services to make certain that business model is financially competitive and not so administratively cumbersome that any negotiated benefits are fully consumed with additional overhead

[29] *http://lamar.colostate.edu/~rtinsley/Genetic%20Pump2.pdf*

costs, as well as making certain the model is sufficiently convenient to attract the majority of the members business needs. If not, then historically the effort will not attract sufficient business to have any real impact on poverty alleviation and collapse once external assistance ends, with ultimately no sustainable benefits to the smallholders.

8. Work with the local agro-dealers to provide most of the support services including production credits. They have always provided the bulk of the services and are the default service providers when development projects collapse without external assistance (Fig 54). This would follow the normal rules for informal credit, but it might need to quietly review if the quoted usury rates are mostly the administrative costs for handling informal credit, factoring in all the games that can be played including adsorbing defaults, and possible discounts given for expedient repayments[30]. This may require some micro-finance assistance, which should be facilitated.

Fig. 54. Local Agro-Dealer in Nigeria That Provides Most of the Inputs to Small Farmers of Rice Or Other Crops.

9. As part of the overall effort at drudgery relief and to expedite the crop establishment, facilitate increase access to privately owned and operated tractor for contract mechanization. This would be mostly for the areas were rice is promoted with the small pumps. The use of tractors should not be restricted to the rice areas, but the entire area as enhancing the millet and cowpea production will also enhance the rice production by reducing the time to establish the millet and expedite when farmers can start to concentrate on rice production. However, be very careful of organizing the rice cultivation in “estate mode” that has never been sustainable and usually causes some ill will. Likewise, avoid relying on any public sector or other forms of communal ownership of tractors and other mechanical equipment. This has been discredited for over 40 years as easily shown by the lineup of out-of-service tractors with less than half the 10,000 designed operating hours in the back area of most ADP in Nigeria including Sokoto (Fig. 55).
10. While the areas with the small pumps could not justify small combines for lack of sufficient opportunity, they could benefit from a few locally fabricated small IRRI designed axle-flow threshers. These should provide a more complete threshing recovery as well as cleaner grain free from chaff and empty grains, thus eliminating or at least reducing the winnowing needs. It will not necessarily remove any stones or mud clods. If

[30] *http://lamar.colostate.edu/~rtinsley/InformalCredit.htm*

the thresher owner/operator claimed 5 to 10% of the crop as an in-kind payment, it would be appropriate and most likely be recovered by the more complete grain recovery in addition to the reduce time and drudgery from manual whacking threshing. For the area below the dam, consider introducing some small combines but only with individual ownership and operators.

Fig. 55. Line-Up of Out-of-Service Tractors at Sokoto, ADP.

11. Look at the possibility of inserting some manual winnowing or grain cleaning machines into the different communities. These should allow for a cleaner bag of grain that could command up to 10% higher price from the traders. The suggestion would be for the community grain dealers to obtain them and allow them to be used at the drying floors, and when grain is brought for sale. They actually have the most vested interests in grain cleaners and have volume and continuous local need for them to justify the cost.
12. If all sales are cash at the change of custody, the farmers' direct involvement in the value chain will end with the sale to the local community buyer. However, the farmer could still benefit from enhancing the value chain further up by making the various components more efficient.

Processing Component: Improving the processing will involve making improvements to both the parboiling process and milling.

The parboiling effort appears to be reasonable and provides an acceptable quality of parboiled paddy to proceed to the mills. There are more sophisticated parboiling equipment like that observed in the abandoned mill, but these may be too expensive to operate and thus will impose higher prices on the consumer that would make it difficult for them to afford the resulting rice. However, health concerns are more than worth considering and addressing. Unfortunately, the health problems are long term while the economic projections remain short term. Thus, while there are improved less smoky small-scale parboiling vats suitable for family enterprises developed and promoted by some NGOs, they may be hard to promote for their health concerns, and thus may have to be promoted for their fuel efficiency and reduced need to obtain firewood. This should be vigorously promoted, with some microfinance made available to assist family enterprises to purchase the improved vats and a good economic analysis on costs benefits concentrating on greater fuel efficiency. It might also we worth evaluating the use of propane for fuel the parboiling operations and other rural energy needs.

The milling appears to have amble opportunity for improvement simply by shifting from the present single phase mills to the Sakata style single pass two phase mills. The 50% increase in recovery should more than offset the extra capital costs for the mill as well as the extra operating cost and provide the consumer a better quality product without any increase in the price. However, to be on the safe side a detailed economic analysis needs to be undertaken to confirm the benefit and estimate how long before the benefits will recover the costs including capital, interest and operating costs, etc. It was a little disconcerting during the field visit to have to chase down the key to visit the new Sakata mill, while there was major activity around the single phase mill. There may also be a need to looks at some form of institutional credit to help potential millers purchase the Sakata style mills. They cost around US$4000 ex-factory. In considering Sakata mills with de-stoners in front it might be desirable to allow direct access to the mill instead of going through the de-stoner to access the mill. Thus when clean bags of paddy are available for milling they will not have to go through the de-stoner with some grain losses occurring.

Marketing Component: It is not certain what can be done with the marketing. Most likely the bulk of the rice will continue to be sold through the open air market ladled from the 100 kg/ bulk bags to display pan. There are comments about trying to develop smaller five to 10 kilogram consumer bags to be sold through the supermarkets. This needs to be done with caution as the extra costs of bagging may not be recovered from extra price being charged. This is really addressing a small niche market of people who will not be consuming large volumes of rice. Also, this could introduce an extra middle man at the supermarket warehouse. This would increase the overhead costs and lower what the bagger would receive. Thus this will require an exceptionally detailed economic evaluation before proceeding. Also note that many convenience stores may prefer buying the 100 kg bulk bags and then rebagging into one and two kilo retail bags, and able to do so in breaks between customers, and thus with nominal labor costs and less durable bags, etc. If this is the case it could be difficult to compete with.

Other Enhancements

Roads & Transportation: Another area to consider in enhancing the rice value chain that could quickly impact on farmers is the quality for the roads particularly the feeder roads that server rural communities. Typically once you are off the tarmac the transportation costs as expressed in ₦/mt/km can triple even when still using lorries. This may be a nearly transparent additional cost when factoring in:

- Smaller vehicle with less load capacity for off tarmac use.
- Trans-shipment of goods to or from the smaller vehicle somewhere near where the tarmac and unpaved roads meet.
- Warehouse space and storage costs to make the transfer.

- Additional fuel because the smaller vehicle, while consuming less fuel per trip but because of the need for extra trips, are actually less fuel efficient on a mt/km basis?
- Additional time required to travel each km on unpaved road, increasing the labor costs.
- Additional number of trips to deliver or pick-up the same amount of commodities, again increasing the labor costs.
- Additional fuel required due to slower travel with more frequent braking, accelerating, etc.
- Additional frequency of repairs, from more bouncing around, adding wear and tear to the suspension, brakes, axles, etc.

These additional costs have to be borne directly by the farmers as a discount on what the traders will pay for the paddy since, once they get to the highway, they have to compete with less remote paddy that does not incur the extra costs. Thus improved feeder roads quickly trickle down to the remote farmers.

This analysis is for lorries, when the road conditions are too poor for lorries, farmers than have to rely on 4-wheel drive vehicles and take the time to market individual bags (Fig. 56). That is time taken away from additional crop husbandry work that can increase yield or quality of the crops.

Fig. 56. Transporting Good for Areas to Isolated for Lorry Access in Kenya.

Micro-Finance: As presented above much of the enhancement of the rice value chain will require some capital investment. This would include funding for individual purchase of power tillers for paddy cultivation, tractors for upland cultivation, combines, threshers and cleaners, as well as improved parboiling vats, and improved mills. Thus part of the enhancement effort may need to evaluate micro and other forms of institutional finance. This may require a look at how rural financial assistance is structured and divide loans into two types. One would be larger loan for capital inputs such as the machinery mentioned above that has a downstream synergy of supporting the small rice farmers. These could be secured loans as the equipment procured could serve as collateral. Under no circumstances should machinery ownership be vested in anything other than individual ownership, as joint ownership of equipment either public sector or even cooperatives has been discredited for over 40 years as clearly noted at the Sokoto ADP (Fig.55). The other would be operational loans that would cover the operating costs of the machine or even agro-dealers providing fertilizer, seed and other inputs. The operational loans might best go to the service provider instead of the farmers so the providers can provide credit to the farmers to cover production costs for fertilizer, seed, chemicals, as well as contract tillage. These service providers may be the best administrators of production credits as they usually know the farmers personally and deal with them individually. Yes, this will be under informal credit rules with the quoted usury rates, but this needs a real evaluation so see how much is administrative costs for

excessive games farmers can play to avoid or delay repayments, and how much represents excess profits, if any. This would include discounts for prompt payments with clean bags of grain[31].

Miscellaneous Inputs

There were a couple issue brought up that were outside the basic value chain analysis. These were:

Abandoned Mill

This was a government owned mill in a neighboring Kebbe State that has been set up on an exposed slab of concrete and left unused and unprotected from the weather for over six years (Fig. 57). It was actually a relatively small 150 to 200 kg/hr Sakata Style mill (Fig. 58), with a separate de-stoner and parboiling equipment, with the de-stoning preceding the parboiling. The parboilers were two large elevated vats to be heated by steam injected (Fig. 59). Once parboiled the paddy would be dumped into a force air dryer. This looks like an expensive process that my not compete with the family enterprises parboiling operations.

Fig. 57. Government Sponsored Rice Mill Abandoned and Exposed for Six Years.

Fig 58. Small Sakata Style Mill As Part of the Abandoned Mill Complex.

Since the mill had been left exposed to the elements for six years it would be questionable that it would work and most of the gears rusted and belts cracked. The recommendation here would be to first get a good local mechanic to inspect all the equipment and see what can be salvaged and what has to be discarded, as well as what spares would be needed to bring it into operation. If it is feasible then provide proper housing for the mill prior to making any repairs. Evaluate the parboiling equipment independent of the rest of the equipment as most likely that will not be competitive enough to be utilized and will thus have to be abandoned.

[31] http://lamar.colostate.edu/~rtinsley/InformalCredit.htm

Fig. 59. Steam Injected Parboiling Vats above Forced Air Dryer at Abandoned Mill.

Dae Sung Agriculture Machinery Ltd.

Reference was made to Dae Sung Agriculture Machinery Ltd. as a source of mills and other rice production and processing equipment. Thus upon return to Abuja their local facility was visited. Dae Sung is a Korean based agro-equipment dealer that can import and sell a large range of agriculture machinery most of which is designed for use with rice. This includes mills, de-stoners, parboilers, threshers, power tillers and even small combines. The basic concern was for their promoted 300 kg/hr mill (Fig. 60). This was examined in detail, and it appears a reasonable mill that could work. Also, Korean machinery does have a good reputation for quality and durability. However, the equipment is mechanically complex and thus could require more extensive repairs in the future. Thus for rice mills the recommendation remains the Sakata style mills. They are just mechanically simpler thus repairs should also be easier and less expensive in the long term.

Fig. 60 Korean Manufactured 300 kg/hr. Destoning Rice Mill.

Summary

The value chain for Rice in Sokoto is similar to the value chain for most commodities operating in financially suppressed economies common to most developing countries such as Nigeria. The value chain can produce and deliver rice to the consumers at prices the consumer can afford. It is composed of a multitude of single family enterprises that undertake the various services needed to produce, process, and finally market rice, with associated links. While the system is highly fragmented, it is a business model that minimizes costs and thus could be difficult to compete with.

The best way to enhance the value chain maybe to concentrate on the production phase. This is where the potential maybe the greatest as the yields are unnecessarily low and could be substantially increased by creating a more favorable overall production environment. First among this would be to increase the rice areas farmers have access to so they will become more interested in rice instead of having rice a minor crop in their overall farm enterprise system. The

next effort would be to reduce the drudgery through facilitating an increase in mechanization or access to mechanization. This would include both expedient crop establishment and harvest where the need shift to improving the overall recovery as well as the quality in terms of eliminating the stone and other debris.

It would also be possible to enhance the value chain at the processing facilities. For the parboiling the need would be to encourage better vats that would be less smoky, but this will need to be promoted more for saving on firewood, than the more serious concern for long term health of the women doing the parboiling. It might also be possible to take a critical look at propane as the primary fuel. This would not only eliminate the need for firewood, but also enhance the environmentally desirable reforestation programs. As for milling the critical concern would be to shifting from the single stage mill, to a two-stage mill. This should both increase the recovery by 50% but also enhance the quality.

There may be less opportunity for enhancing the value chain at the marketing as this will most likely remain open marketing with bulk 100 kg bags being displayed in larger pans to consumer for bulk purchase. The possibility of small packaging for supermarket use should be addressed with caution to make certain it can be done in a profitable manner, and not be undermined by convenience store undertaking this value added on their own and at a competitive advantage.

Because of the importance of cash transaction, the inconvenience of consignment marketing, as well as limited labor, it is unlikely the farmer will want to become actively involved in the value chain beyond the original sale to the local buyer that is accumulating enough paddy to justify a full lorry load. The farmers are more likely to want to outsource any value added beyond that point. However, enhancing the value chain beyond this level can still have favorable impact on the farmers.

Activities Log
RL Tinsley – Winrock International FtF Volunteer
Rice Value Chain Analysis – Sokoto State Nigeria (NIG 244)

Fri. 1 June Departed 6:30 am for Abuja Nigeria with connection in JFK and stop in Accra, Ghana.

Sat. 2 June Arrived Abuja 14:30 after some 30 hours travel. Meet briefly with Mike Bassey, the FtF country director, and got settled into their guest facilities.

Sun. 3 June Flew to Sokoto to begin assignment. In the evening met with the host representative, Sani Kabir and Aminu Aliyu who provided a details training schedule for the extension officers, starting with participant registration early the next day, Monday, with technical presentation by me expected to follow starting around 9:30. This came as big surprise as I figured as if I had the chance would insist on spending several days getting familiar with the area and rice production and processing in the area so any training could be adjusted to the specific needs of the area. Thus I spend most of the evening preparing for an extended general lecture. I later noted that the world "training" was not used in the initial announcement that I responded to, nor in the final SOW I was provided.

Mon. 4 June Went through the formalities of meeting the agriculture leaders with the commissioner for agriculture Dr. Mohammed Jabbi Kilgoro and the program coordinator for Sokoto state IFAD Aminu Aliyu Dogon Daji then settled down to about 3 hours of lecturing. I was able get some concepts introduced, but also made arrangements to spend the next 3 days on field visits.

Tue. 5 June Had a field trip to Kwarre, accompanied by all participants for an entourage in excess of 20 people, to visit a relatively small rice growing area that was of special interest to the extension program. It was only a total of 75 ha divided into 150 farmers for less than a 0.5 ha/farmer. This was recognized as insufficient and thus most farmers also managed several hectares of upland crops, mostly millet, sorghum, and cowpeas. Thus the old conflict between upland and irrigated paddy. The paddy was irrigated by undeveloped tube well with small petro engines like seen in Zambia for off-season vegetable production out-competing the highly promoted treadle pumps. They are nice and portable, but only discharge about 3 lit/sec. If operated continuously 24 hour a day could pump enough water for 3 ha, but doubt they irrigate at night for security reasons. Yields were estimated at 2.5 mt/ha (25 bags). They were seriously thinking of somehow installing a high

quality rice mill, but question if area could generate sufficient volume to justify the mill. Total production would be only 225 mt.

Wed. 6 June Field trip again accompanied by all participants to visit Kalambaina a rice processing community that appeared involved in parboiling and milling rice on contract. The visit really comprised two mills and a parboiling process. The first mill was a Sakate 2-stage single pass mill with de-stoner/cleaner attached. It was only 2 months old and looked ideal for milling reasonable but not international quality rice. However, there was little activity surrounding it, and we had to chase down the operator to get the key for the visit. The second mill was the more traditional single stage mill that appears most common for milling rice in Nigeria and other parts of West Africa. It was surrounded by considerable more activity, even though it produced twice the broken with some stones as well, and had 50% less recovery. The parboiling was typical of that seen elsewhere in Nigeria.

Thu. 7 June Again with the complete group, visited Goyonro local government area to see 2 more rice producing areas. The first was an area they were introducing rice to. It was similar to the first area with rice being in the upper part of a flood area where there might be a potential for deep water rice production with elongating lines. The idea was to use a sufficiently early maturing variety to avoid the flood. Again the irrigation was based on the same small petro pumps from undeveloped tube wells. The soil was more clay, making for better holding water, and the crop looked better. Then at my request proceed to a major irrigated rice area below the major dam in the area. This was more typical of major rice production. It was a total of several thousand ha, but allocations were one acre per farmers, and thus farmers had more land outside the scheme planted to mostly millet and cowpea from which they obtained most of their returns. This would be a good place to push for the Thai model, if the farmers were provided enough land to be full time rice farmers.

Fri. 8 June This was a day at the rice market, with only a limited number of people. It did involve the wholesale market with a few retailers outside. Apparently the wholesalers contract with someone to take a truck some 160 km to buy up to 200 bags, 20 mt of paddy, deliver it to a processing area, remain with it while being processed, and then bring it to the wholesale market. One need is to determine why not process the rice closer to the production area? Again everything typically fragmented into family enterprises. Did get into a discussion on health issues started with concern for porters working with 100 kg bags, but shifted to concern with women involved in parboiling, and long term exposure to smoke resulting in

depreciated eye sight and TB by the time they reached 40. Still need to visit multi-commodity open air retail market and supermarket.

Sat. 9 June Back to the classroom for the second day of "training". I was able to provide a 50 slide lecture/discussion over a 3 to 4 hrs period and adjusted to the field visits.

Sun. 10 June Presumed day off, so remained in hotel to work on next presentation.

Mon. 11 June This was a long field trip accompanied by everyone to Kebbe local government area to look at an unused rice mill that has been exposed to the elements for some 6 years, and may be beyond salvage. It did have a very elaborate parboiling component based on steam generator and force air dryer. Also, a deep water swamp rice area with a possible 200,000 ha involved. It was beginning to flood, so it could only be observed from the road.

Tue. 12 June After considerable power delays made the final presentation, allow participants to break into work groups, then took off for final market visit to collect missing pictures.

Wed. 13 June Expecting a relatively brief wrap up training effort with groups presenting their ideas for an action plan, but it was totally preempted by John Iruaga who gave a rambling condescending lecture on action plans and the specific inputs by the participants. Finally had to forcefully terminate the program so training certificates could be handed out. Also, prepare to return to Abuja

Thu. 14 June Return to Abuja

Fri. 15 June Had debriefing meeting with Abdulkadir Gudugi and Nduka Okaro of USAID, the visited Dae Sung Machinery & Construction company. They have a full range of paddy producing and processing equipment. However, this is a Korean company and the equipment most likely is good, but it is mechanically fairly complicated and thus could result in more extensive repairs later on. Late in the day met with Mike Bassey and reviewed my concerns with the program, particularly the sudden shift from an information gathering evaluation to a compulsory comprehensive 2-week training program and the preemptive final day lecture, replace participant reports.

Sat. 16 June Had brief last minute meeting with Jack Moulton concerning my work at the Kpong Irrigation Scheme in Ghana. He is most a cooperative organization specialist but acknowledge that the overall administrative and economic environment is not conducive to cooperatives. Departed for the USA

Sun. 17 June Arrived home on schedule, end of activities log.